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Influence of Close-Up Starting Programs on Performance of Light-Weight Feedlot Steers Calves during the Early Receiving Period

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Abstract

The influence of close-up feed strategies on growth performance and dietary NE in light-weight feedlot steers during a 56 d receiving period was evaluated. Dietary treatments were formulated to meet the average metabolizable amino acid requirements of calves during 1) the initial 7 d; 2) the initial 14 d; and 3) the initial 21 d following arrival into the feedlot, assuming average interval DMI of 2.8, 3.0, and 3.6 kg/d, respectively. Thereafter, all steers received dietary treatment 3. Fish meal was the source of supplemental protein. One hundred eight medium-framed crossbred steers (168.4 ± 5.0 kg) were blocked by weight and assigned to 18 pen groups (6 steers per pen). P-value (≤0.10) was considered as statistically significant. Daily weight gain (linear effect, P = 0.09) and gain efficiency (linear effect, P = 0.08) decreased as the close-up interval increased. DMI was not influenced by feeding program (P = 0.46). The ratio of observed to expected dietary NEm (linear effect P = 0.06) and NEg (linear effect, P = 0.05) decreased as length of close-up interval increased. Morbidity was low (18%) and not affected (P > 0.40) by dietary treatments. It is concluded that the addition of a close-up diet formulated to meet the metabolizable amino acid requirements of shipping stressed calves during the initial 7 d in the feedlot, when feed intakes are comparatively low, will have long-term beneficial effect on cattle growth performance and dietary NE.

Keywords

Amino acid, Cattle, Receiving Period, Diets

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1. Introduction

Receiving diets are typically formulated to meet the average protein requirements of calves during the course of the receiving period; however, feed intake during the first few weeks, when cattle are adapting to the feedlot environment, is characteristically low [1] [2]. Consequently, during this period protein nutrition may be grossly inadequate [3]-[5]. Fluharty and Loerch [6] found that during the initial 28 d receiving period newly arrived feedlot calves (226 kg) fed a 16% CP diet had greater gain efficiency, than those fed a 12.5% CP diet. However, treatment effects on weight gain were only evident during first week, when DMI was low. The potential for protein deposition is a function of both energy intake and metabolizable protein supply [7]. Most of the previous work evaluating protein nutrition during the receiving period has involved heavier weight calves or light yearlings [8]. The objective of the present study is to examine the influence of close-up feed strategies, matching metabolizable protein supply to expected DMI during the initial 7, 14, or 21 d of the receiving period, on 56 d growth performance and dietary NE in light-weight feedlot steers.

2. Materials and Methods

One hundred eight medium-framed crossbred steers (168.4 ± 5.0 kg) originating from the Fortworth, Texas market area were trucked to the University of California, Desert Research and Extension Center. Upon arrival, calves were branded, castrated (elastration), vaccinated for IBR-PI3 (TSV-2, Zoetis, Inc., New York, NY), Clostridials/Haemophilus (Ultrabac 7, Zoetis, Inc., New York, NY), treated for internal and external parasites (Ivomec Plus, Merck, Rahway, NJ), injected with 500,000 units vitamin A (Vita-jec A&D 500, RXV Products, Porterville, CA), and implanted with Synovex-C (Zoetis, Inc., New York, NY). Calves were blocked by arrival weight and assigned at random within weight groupings to 18 pens (6 steers per pen). Pens were 43 m^2 with 22 m^2 overhead shade, automatic waterers, and 2.4 m fence line feed bunks. Dietary treatments (**Table 1**) were formulatedto meet the average metabolizable amino acid requirements of calves [9] during: 1) the initial 7 d; 2) the initial 14 d; and 3) the initial 21 d following their arrival into the feedlot, assuming average interval DMI of 2.8, 3.0, and 3.6 kg/d, which correspond to 1.66%, 1.78% and 2.14% of BW, respectively. The DMI was estimated according to NRC [9]. After receiving respective close-up treatments, cattle were switched to dietary treatment 3 for the remainder of the 56 d feeding period. Calves had ad libitum access to feed. Fresh feed was added twice daily. The initial weight was the off-truck arrival weight. In the calculation of steer performance final live weights were reduce 4% to adjust for digestive tract fill. Estimates of steer performance were based on pen means. Net energy values for each diet were calculated from estimates of energy gain (EG, Mcal/d) based on growth-performance; EG = 0.0557 BW$^{0.75}$ (ADG$^{1.097}$), where EG is the daily energy deposited (Mcal/d), BW is the mean shrunk body weight (full weight × 0.96) and maintenance energy expended (EM, Mcal/d); EM = 0.077 BW$^{0.75}$ [10]. Dietary NEg was derived from NEm by the equation: NEg = 0.877 NEm − 0.41 [11]. Dry matter intake is related to energy requirements and dietary NEm according to the equation: DMI = EG/(0.877 NEm − 0.41), and can be resolved for estimation of dietary NE by means of the quadratic formula: x = (−b ± (b2-4ac)$^{0.5}$)/2c, where x = NEm, a = −0.877 DMI, b = 0.877 EM + 0.41 DMI + EG, and c = −0.41 EM [11].

Treatment effects were tested by means of orthogonal polynomials. Performance (gain, gain efficiency, and dietary energetics) data were analyzed as a randomized complete block design; the experimental unit was the pen. The MIXED procedure of SAS (SAS Inst. Inc., Cary, NC) was used to analyze the variables. Treatments effects were tested using the following contrasts: 1) linear effect of the days of program, and 2) quadratic effect of the days of program. P-value (≤0.10) was considered as statistically significant. Effects of treatment were determined according to SAS (SAS Inst., Inc., Cary, NC; Version 9.1).

3. Results and Discussion

Treatment effects on growth performance responses of steers are shown in **Table 2**. Morbidity was low (18%) and not affected (P > 0.40) by dietary treatments. There were no treatment effects (P > 0.10) on DMI. Mean DMI was 4.2 kg/day, 16% lower than otherwise expected (4.96 kg/day) for calves of that BW and NE content of the diets [9]. This lower level of intake reflects, in part, the adaptation of calves to eating complete mixed diets from a feedbunk during the receiving period [1] [5] [6].

Average daily gain (linear effect, P = 0.09) and gain efficiency (linear effect, P = 0.08) decreased as the length of the close-up interval increased. Improved ADG and gain efficiency observed in present study are consistent

Table 1. Ingredients composition of experimental diets fed to steer (% DM basis).

Items	Close-up treatment diet		
	1 - 7 d	1 - 14 d	1 - 21 d[a]
Alfalfa hay	15.00	15.00	15.00
Sudan grass, hay	15.00	15.00	15.00
Corn, steam flaked	51.30	53.30	54.30
Yellow grease	2.00	2.00	2.00
Molasses cane	8.00	8.00	8.00
Urea	0.10	0.10	0.10
Fishmeal	7.70	5.70	4.70
Limestone	0.20	0.20	0.20
Magnesium, oxide	0.20	0.20	0.20
Trace mineralized salt[b]	0.50	0.50	0.50
Nutrient composition (DM basis)[c]			
DE, Mcal/kg	4.07	4.10	4.11
ME, Mcal/kg	2.92	2.94	2.94
NE, Mcal/kg			
Maintenance	1.98	2.00	2.00
Gain	1.33	1.35	1.35
Crude protein, %	15.80	14.63	14.05
UIP, % of CP	42.63	41.21	40.40
DIP, % of CP	57.37	58.79	59.60
Calcium, %	0.89	0.78	0.73
Phosphorus, %	0.49	0.43	0.40

[a]Diet for remainder of the 56 d. [b]Trace mineral salt contained: $CuSO_4$. 068%; $CuSO_4$, 1.04%; $FeSO_4$, 3.57%; ZnO, 1.24%; $MnSO_4$, 1.07; KI, 0.52%; and NaCl, 92.96%. [c]Based on tabular values for individual feed ingredients (NRC, 1984 [10]) with the exception of supplemental fat, which was assigned NEm and NEg values of 6.03 and 4.79, respectively (NRC, 1996 [9]).

responses to improved protein nutrition of newly arrived feedlot calves [5] [6] [11]-[13]. Fluharty and Loerch [5] observed improved ADG and gain efficiency of newly received calves (238 kg) following a step-up program using diets with 23% CP during wk 1, 17% CP during wk 2, and 12.5% CP during wks 3 and 4. Zinn and Owens [14], conducted an 84 days experiment with growing steers (initial weight 198 kg) fed a 12.2% CP basal diet supplemented with 2%, 4% and 6% of a rumen escape protein blend (blood meal, feather meal, meat and bone meal), the CP of those diets were 13.4%, 14.6% and 15.8% respectively. They observed that during first 28 days, ADG increased linearly with increased UIP protein intake.

In previous studies exploring the influence of protein supplementation in newly arrived cattle, cattle did not receive growth implants [5]-[7] [12] [20]. However, in the present study, steers received growth implants, as is the common practice in the industry [8]. Hormonal implants enhance amino acid uptake by muscle cells [15], increasing the number of satellite cells, rate of cell proliferation, and protein synthesis, and decreasing rate of protein degradation [16]. The net effect is a potential for increased N retention, provided cattle receive adequate metabolizable protein [17]-[20]. When diet formulations do not provide adequate metabolizable protein the partial efficiency of energy utilization for maintenance and gain is proportionally depressed. Accordingly, in the present study the observed/expected ratio of dietary NEm (linear effect, P = 0.06) and NEg (linear effect, P =

Table 2. Treatment effect on 56 d growth performance of steers.

Item	Close-up treatments diets			P values		
	1 - 7 d	1 - 14 d	1 - 21 d	Linear	Quadratic	SEM
Days on test	56	56	56			
Pens	6	6	6			
Live weight, kg[a]						
Initial	168.4	170.1	166.8	0.58	0.34	2.024
56 d	228.6	227.1	220.8	0.09	0.53	3.026
DMI	4.21	4.19	4.08	0.46	0.75	0.118
ADG	1.07	1.02	0.96	0.09	0.98	0.043
ADG/DMI	0.257	0.242	0.236	0.08	0.68	0.008
Dietary NE, Mcal/kg						
Maintenance	2.09	2.03	2.00	0.11	0.82	0.040
Gain	1.43	1.37	1.34	0.11	0.82	0.035
Dietary NE, observed/expected						
Maintenance	1.06	1.02	1.00	0.06	0.66	0.020
Gain	1.07	1.02	0.99	0.05	0.64	0.026
Sick days	1.75	2.17	2.08	0.66	0.70	0.522
Morbidity, %	16.67	16.67	22.22	0.48	0.68	5.422

[a]Initial weight is the off-truck arrival weight. Final BW was reduced 4% to account for fill.

0.05) decreased as length of the close-up interval increased. Likewise, Schroeder *et al.* [7] observed that when energy intake increases in absence of adequate metabolizable amino acid supply, N retention of beef steers is not enhanced, and consequently, gain efficiency is depressed.

4. Conclusion

It is concluded that addition of a close-up diet formulated to meet the metabolizable amino acid requirements of shipping stressed calves during the initial 7 d in the feedlot, when feed intakes are normally comparatively low, will have long-term beneficial effect on cattle growth performance.

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