Effect of Conventional vs Restricted Adaptation to a High-Concentrate Diet on Performance and Carcass Characteristics of Feedlot Calves

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Story in Brief

Limit feeding of the final diet compared with adaptation using decreasing roughage has been shown to improve feed efficiency and decrease the amount of roughage required during the initial adaptation in yearling cattle. However, little information is available concerning this method of adaptation in calves. The objective of this study was to evaluate the effects of limit feeding the final diet vs ad libitum feeding of four step-up diets on performance and carcass traits of calves. The two treatments were: 1) ad libitum feeding of four step-up diets over a 20-d period with levels of DRC increasing from 52 to 80%, or 2) limit feeding of the final diet with predetermined increases in intake until ad libitum intake was achieved. Initial intake of limit-fed steers was calculated to meet energy intakes equivalent to that of ad libitum steers consuming 2% of BW. Slick bunk management was used and bunks were read once daily at 0700, approximately 1 h prior to feeding. Steers were fed once daily. Daily gain was greater for ad libitum steers compared with limit-fed steers (3.59 vs 3.28 ± .04 lb). Daily intake was lower for limit-fed steers (19.80 vs 20.99 ± .18 lb), whereas the resulting feed:gain tended to be improved for ad libitum steers. Final BW and hot carcass weight were decreased when steers were limit fed the final diet during adaptation as opposed to ad libitum adaptation. Use of limit feeding in this experiment reduced daily gain and carcass weight; therefore, this method of adaptation may be more efficacious in yearling cattle than calves.

Key Words: Limit feeding, Adaptation, Calves

Introduction

Feeding management of feedlot cattle is an efficiency driven business in which cost of gain is the primary target. Many things can affect cost of gain in a feedlot; however, there are two times during the finishing period in which management can play a key role in either increasing or reducing cost of gain. These two time periods are the initial adaptation phase and the last approximately 28 d on feed prior to harvest. The problem with the final phase is one of decreased efficiency associated with increased fat and reduced protein deposition. The management problem addressed in this experiment was related to efficiency problems associated with the initial adaptation phase in which cattle previously adapted to a high-roughage diet are introduced to a high-concentrate diet in a short period of time. This adaptation has historically been achieved by immediately introducing cattle to a 50 to 65% concentrate diet on an ad libitum basis. Following this introduction the amount of roughage in the diet is decreased every 3 to 7 d until the desired concentrate level is achieved. This method of adaptation requires feedlots to purchase and handle roughage, which is an expensive source of energy compared with cereal grains and also requires more space for storage. In addition, frequent diet changes alter ruminal fermentation, which might have negative effects on intake and final animal performance. In this experiment we attempted to alleviate some of these inefficiencies by limit feeding the final diet as opposed to ad libitum adaptation with decreasing roughage levels. Limit feeding the final diet removes the need for high levels of roughage as well as the weekly diet changes associated with ad libitum adaptation.

Materials and Methods

Animals and Diets. One-hundred-fifty mixed crossbred steer calves (BW = 636 ± 3 lb) were received at the Willard Sparks Beef Cattle Research Center, Stillwater, OK, in the spring of 2000. Upon arrival, steers were individually weighed on three consecutive days (d -1, 0, and 1); on d -1 steers were individually ear-tagged for identification. On d 1 steers were processed, blocked by the average individual weights taken on d -1 and 0, and allotted to one of 30 pens (10 pens/block; 5 hd/pen) where Blocks 1 and 2 were fed for 165 d, and Block 3 was fed for 180 d. At processing all steers were vaccinated with BRSV VAC 4®, and treated for internal and external parasites using Ivomec® injectable. Also at processing steers were assigned to one of two treatments: 1) ad libitum feeding of four step-up diets over a 20-d period with levels of DRC increasing from 52 to 80% (DM basis), or 2) limit feeding of the final diet with predetermined increases in intake until ad libitum intake was achieved. Diets and dietary analysis are presented in Tables 1 and 2. Initial intake of ad libitum steers was set at 2% of BW (DM basis) and intake was increased by 1lb/hd/d when a slick bunk was evident on two consecutive days. Initial intake of limit-fed steers was calculated using the computer model of the 1996 Beef Cattle NRC. Intake of the final diet was manipulated so that steers consuming the final diet would gain similar weight to ad libitum steers consuming 2% of BW (DM basis) of the 65% concentrate (Diet 1) diet; therefore, initial intake of limit-fed steers was set at approximately 1.65% BW (DM basis). Intake of limit-fed steers was increased .5 lb/hd/d when a slick bunk was evident on two consecutive days. Intakes for both treatments were similar by approximately d 45. Variation in DMI during the grain adaptation period was calculated separately for each treatment by two methods. In the first method, residual intake (for each pen) was calculated as estimated daily DMI minus the average DMI for all days within the concentrate period for that pen. In the second method, residual intake was calculated as estimated daily DMI (for each pen) minus the average DMI for all pens within treatment for each day. Intake variation was calculated on intake residuals within a pen across all days in the grain adaptation period (pen DMI variation), or on intake residuals within the day among all pens within the treatment (daily DMI variation).

Table 1. Dietary composition (DM)

	% Concentrate			
Ingredients, %	65	75	85	92.5
Rolled corn	52.5	62.5	72.5	80
Cottonseed hulls	17.5	12.5	7.5	7.5
Alfalfa, dehy	17.5	12.5	7.5	--
Yellow grease	3.0	3.0	3.0	3.0
Supplement[a]	9.5	9.5	9.5	9.5

[a]Supplement ingredients (% DM basis) SBM 47.7 = 4.00, Wheat midds = 1.751, Vit A-30 = .011, KCL = .2, Rumensin 80 = .019, Tylan 40 = .013, Dical = .5, Limestone 38% = .9, CSM = 1.0, Salt = .25, Urea = .85, Manganous oxide = .003, Zinc sulfate = .003

Table 2. Calculated analysis of diets				
	% Concentrate			
Nutrient, DM %	65	75	85	92.5
NEm Mcal/cwt	85.92	89.87	94.81	98.52
NEg Mcal/cwt	50.29	55.45	60.39	63.07
Crude protein	13.9	13.8	13.7	13.1
Ether extract	6.15	6.34	6.52	6.61
Crude fiber	14.54	11.06	7.58	5.78
Calcium	.77	.69	.62	.51
Phosphorous	.37	.39	.40	.40

Steers were housed in 30 partially covered pens. Pen shades primarily functioned as shade for the steers, and to protect the feed bunk from precipitation, which allows for more accurate measure of feed intake. Steers were weighed on three consecutive days at arrival, every 2 wk for the first 28 d, and every subsequent 28 d for the duration of the experiment. All intermittent weights were subjected to a 4% shrink, and final live weights were calculated by dividing each animal's hot carcass weight by the average dressing percentage for steers harvested on the same day. Average dressing percentages were 64.2% for Blocks 1 and 2 (harvest 1), and 61.7% for Block 3 (harvest 2).

Steers from weight Blocks 1 and 2 (heavy and medium) were harvested after 165 d on feed and Block 3 (light) was harvested after 180 d on feed. All steers were harvested at Excel Corporation, Dodge City, KS. At harvest, steer identification was transferred to their corresponding carcass. Carcass weights and percentage of internal fat were recorded, and Elanco Animal Health personnel scored livers for degree of abscesses. Following a 0^{o}C, approximately 36-h chill period, Oklahoma State University personnel collected ribeye area, marbling score, lean and skeletal maturity, 12^{th} rib fat, and recorded USDA Quality and Yield Grades. Loin strips were identified on the right side of a subset of carcasses and were collected during the fabrication process. Loin strips were then transported to Oklahoma State University where they were allowed to age for 7 d. Following the 7-d aging period, a 1 in steak was removed from each strip loin and immediately frozen at -80^{o}C. Steaks were tempered overnight at 0^{o}C, cooked in an impingement oven to a 70^{o}C core temperature and allowed to cool to room temperature prior to shear force evaluation. Six, 1.25 cm core samples were removed from each steak and shear force was evaluated using a Universal Instron Testing machine with a Warner Bratzler shear head attachment.

Statistical Analysis. Data were analyzed as a randomized complete block design using the GLM procedure and a least squares model that included block and feeding regime (SAS Inst. Inc., Cary, NC). Pen served as the experimental unit for gain, dry matter intake, and efficiency data, and steer was used as the experimental unit for carcass parameters.

Results and Discussion

Feedlot Performance (Table 3). The use of limit feeding the final diet as a means of adapting calves to a high-concentrate diet decreased overall daily gain by 9.5% when compared to ad libitum intake of four step-up rations. Limit-fed steers, as expected, had lower overall dry matter intakes (20.99 vs 19.80 ± .18 lb; P<.01) than ad libitum steers. However, this decreased intake was accompanied by a lower ADG (3.59 vs 3.28 ± .04), and the resulting feed efficiencies (5.85 vs 6.02 ± .20; P=.11) for the two treatments were not different. These results are in contrast with those of Weichenthal et al. (1999) and Choat et al. (2000) who observed similar rates of gain in yearling steers (initial BW approximately 845 lb) with lower intakes by the limit-fed steers resulting in an efficiency benefit for steers limit fed the final diet during adaptation. These results suggest that this method of adaptation may be more practical in older, heavier-weight cattle as opposed to calves. While not beneficial from a performance standpoint, the use of limit feeding the final diet as a means of adapting calves to a high-grain diet in this experiment decreased day-to-day intake variation compared with steers fed ad libitum step-up diets, and this may indicate a more gradual adaptation of ruminal microorganisms. However, it should be noted that animal-to-animal intake variation within a pen could not be determined in this experiment.

Table 3. Least squares means for performance of feedlot calves fed for 180 d

	Treatment			
Item	Ad libitum	Limit fed	SEM[a]	P-value
Pens	15	15	--	--
Steers	75	73	--	--
Weight, lb				
Initial	638	639	2.6	.75
Final	1246	1194	9.5	< .01
Daily gain, lb/d				
d 0 – 14	4.67	1.04	.29	< .01
d 15 – 28	4.76	5.53	.24	.03
d 29 – 56	3.96	4.32	.11	.05
d 57 – 84	3.77	3.44	.11	.05
d 85 – 112	3.35	3.44	.11	.59
d 113 – 140	3.19	2.75	.11	< .01
d 141 – end	3.04	3.33	.15	.22
D 0 - end	3.59	3.28	.04	< .01
Intake, lb/d (d 0 – end)	20.99	19.80	.18	< .01
Daily DMI variation, lb[b]				
d 0 – 7	92.75	39.43	4.54	< .01
d 8 – 16	49.69	20.37	1.94	< .01
d 17 – 21	79.03	10.93	14.03	< .01
d 22 - 28	4.19	3.13	1.74	.67
Pen intake variation, lb[c]				
d 0 – 7	26.50	35.20	9.32	.52
d 8 – 16	18.08	55.55	5.88	< .01
d 17 – 21	103.85	111.21	14.19	.72
d 22 - 28	102.20	99.05	7.71	.78
Feed efficiency				

d 0 – 14	3.16	10.10	.40	< .01
d 15 – 28	4.76	3.06	.10	< .01
d 29 – 56	5.29	4.57	.10	< .01
d 57 – 84	5.81	5.75	.10	.89
d 0 - end	5.85	6.02	.20	.11

[a]SEM = Standard error of the least squares means

[b]Daily DMI variation = Residual intake calculated as estimated DMI minus the average DMI for all pens within a treatment for each day. Intake variation calculated on intake residuals.

[c]Pen intake variation = Residual intake calculated as estimated daily DMI minus the average DMI for all days within the concentrate period for that pen. Intake variation calculated on intake residuals.

Carcass characteristics are presented in Table 4. The decreased performance of steers limit fed the final diet resulted in 32 lb less carcass weight when compared to the conventional method of adaptation; however, limit feeding had no other effects on quantitative carcass traits.

Table 4. Least squares means for carcass traits of feedlot calves fed for 180 d

	Treatment			
Item	Ad libitum	Limit-fed	SEM[a]	P – value
Carcasses	75	73		
Hot carcass wt, lb	790	758	6.06	< .01
Fat thickness, in	.55	.52	.02	.52
Internal fat, %	2.56	2.59	.07	.80
Ribeye are, in^2	13.67	13.35	.22	.31
REA/100 lb HCW	1.73	1.76	--	--
Lean maturity[b]	A^{51}	A^{52}	1.64	.89
Skeletal maturity[b]	A^{51}	A^{51}	1.79	.93
Yield grade	2.57	2.50	.08	.59
Liver score[c]	.27	.37	.09	.50
Marbling score[d]	SL^{86}	SL^{92}	8.54	.69
U.S. Quality grade				
Prem. Ch., %	12.2	12.2	--	--
Low Ch., %	29.7	28.4	--	--
Select, %	52.7	54.1	--	--
Standard, %	5.4	4.1	--	--
Shear force, lb	10.8	10.6	.5	.82

[a]SEM = Standard error of the least squares means
[b]Maturity score: “A” = 100, between 9 and 30 mo of age
[c]Liver score: 0 = a normal liver, 1 =”A” (Elanco System for Grading Abscessed Beef Cattle Livers)
[d]Marbling score: SL = 300, SM = 400

Implications

The results of this experiment suggest that limit feeding the final diet can be used to adapt feedlot calves to a high grain diet with some expense in performance and carcass weight. With the limited information in this area more experiments are needed to examine these treatments and there effect in calves versus yearlings of similar genetics and background.

Literature Cited

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