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Case Study: Grain adaptation of yearling steers to steam-flaked corn-based diets using a complete starter feed[1]

E. K. Buttrey,*†[2] PAS, M. K. Luebbe,*[3] PAS, R. G. Bondurant,*† and J. C. MacDonald,*†[4] PAS
*Texas AgriLife Research, Amarillo 79106; and †Department of Agricultural Sciences, West Texas A&M University, Canyon 79016

ABSTRACT

Three hundred six crossbred steers (initial BW = 319 ± 0.5 kg) were used to determine effects of adapting steers to a finishing diet using a complete starter feed (RAMP; Cargill Corn Milling, Blair, NE) for 14 to 30 d on steer performance and carcass characteristics. The RAMP treatments were compared with a traditional step-up procedure (CON). Steers in the CON treatment were adapted from the initial diet containing 45% alfalfa hay (ALF), 32.5% steam-flaked corn (SFC), 20% wet corn gluten feed (Sweet Bran, Cargill Corn Milling), and 2.5% supplement to the final finishing diet containing 65.7% SFC, 20% Sweet Bran, 8% ALF, 3% yellow grease, and 3.3% supplement over a 22-d period. During the step-up period, concentration of ALF was reduced and SFC, yellow grease, and urea were increased. Steers assigned to RAMP treatments were adapted to the same finishing diet using RAMP fed for 14, 18, 22, 26, or 30 d. During adaptation, RAMP decreased and the finishing diet increased. Compared with CON, RAMP increased carcass-adjusted final BW (584 vs. 597 kg; P = 0.05), ADG (1.90 vs. 1.99 kg; P = 0.06), and HCW (372 vs. 380 kg; P = 0.05). As the adaptation period for steers consuming RAMP increased from 14 to 30 d, fat thickness (P = 0.06), and YG (P = 0.01) increased linearly. Adapting steers to a finishing diet using RAMP increases animal BW gain during the finishing phase and reduces the total amount of roughage used by 21 to 28%.

Key words: beef cattle, complete starter feed, grain adaptation, wet corn gluten feed

INTRODUCTION

Cereal grains have historically been fed in feedlot finishing diets because they represented the lowest cost energy source for feeding operations. Accordingly, the infrastructure that has developed within feedlots in the Southern Plains has been designed to efficiently handle and process large volumes of grain. Feeding high levels of roughage in these facilities is undesirable because roughage is an expensive source of energy and because mill efficiency is reduced when handling large volumes of roughage. Yet most cattle entering a feedlot are accustomed to consuming forage, and therefore must be adapted to cereal grains to minimize acidosis (Owens et al., 1998). Brown et al. (2006) noted that the period of grain adaptation is critical because management practices during this time can promote or impair subsequent animal performance and health.

Wet corn gluten feed is a by-product of the wet milling industry and is known to reduce ruminal acidosis in concentrate-fed steers (Krehbiel et al., 1995). Sweet Bran (Cargill Corn Milling, Blair, NE) is a branded wet corn gluten feed product that has an energy value greater than dry-rolled corn (Bremer et al., 2008). Research suggests that carcass weights of steers can be improved by adapting steers to finishing diets using Sweet Bran and a similar amount of roughage that was provided in the final finishing diet (Huls et al., 2009; MacDonald and Luebbe, 2012).

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[2] Present location: Department of Agricultural Sciences, Louisiana Tech University, Ruston 71272.
[3] Present location: Panhandle Research and Extension Center, University of Nebraska, Scottsbluff.
[4] Corresponding author: jcmacdonald@ag.tamu.edu

Table 1. Traditional adaptation diets fed to steers adapted to a finishing diet containing 20% Sweet Bran[1]

Item	Step 1	Step 2	Step 3	Step 4	Finisher
Ingredient, %					
Steam-flaked corn	32.5	40.87	49.25	57.62	65.70
Sweet Bran	20.00	20.00	20.00	20.00	20.00
Alfalfa hay	45.00	35.75	26.50	17.25	8.00
Yellow grease	0.00	0.75	1.50	2.25	3.00
Limestone	1.45	1.45	1.45	1.45	1.45
Urea	0.00	0.13	0.25	0.38	0.80
Supplement[2]	1.05	1.05	1.05	1.05	1.05
Chemical composition, %					
CP	14.76	14.27	13.75	13.27	13.26
NDF	32.28	28.58	24.89	21.20	16.85
ADF	20.92	17.72	14.51	11.31	8.05
Crude fat	1.91	2.77	3.64	4.50	4.97
Ca	1.19	1.08	0.97	0.86	0.74
P	0.35	0.35	0.35	0.35	0.33

[1]Steers consumed steps 1 through 4 for 5, 5, 6, and 6 d, respectively. Sweet Bran, Cargill Corn Milling, Blair, NE.

[2]Formulated to provide a dietary DM inclusion of 0.30% salt, 60 mg/kg Fe, 40 mg/kg Zn, 30 mg/kg Mg, 25 mg/kg Mn, 10 mg/kg Cu, 1 mg/kg I, 0.15 mg/kg Co, 0.10 mg/kg Se, 1.5 IU/g vitamin A, 0.15 IU/g vitamin D, 8.81 IU/kg vitamin E, 33 mg/kg monensin, and 8.7 mg/kg tylosin.

A complete starter feed consisting of Sweet Bran, cottonseed hulls, alfalfa hay (**ALF**), minerals, and vitamins is available for use in adapting cattle to finishing diets (**RAMP**; Cargill Corn Milling). Currently, there is limited information characterizing the use of RAMP to adapt cattle to finishing diets. Additionally, the use of RAMP may alter the optimal length of the adaptation period compared with traditional adaptation procedures. Therefore, the objectives of this experiment were to determine 1) the effects of adapting steers to a finishing diet using RAMP compared with a traditional adaptation strategy on animal performance and carcass characteristics; and 2) the optimal number of days required to adapt steers to a finishing diet when using RAMP.

MATERIALS AND METHODS

All animal care and management procedures were approved by the Amarillo Area Cooperative Research, Education, and Extension Team Institutional Animal Care and Use Committee. Three hundred six crossbred steers (initial BW = 319 ± 0.5 kg) were used in a randomized complete block design to determine effects of adapting steers to a finishing diet using RAMP for 14 to 30 d compared with a traditional step-up adaptation on steer performance and carcass characteristics.

Steers were purchased from a commercial order buyer and had been managed on forage resources before arrival to the research feedlot. Upon arrival at our facilities and before initiation of the experiment, steers were limit-fed (1.75% of BW) a common diet containing 72.5% ALF, 20% Sweet Bran, 5% molasses, and 2.5% supplement for 7 d to minimize differences in gut fill (Klopfenstein, 2011) and individually weighed on 3 consecutive days (Stock et al., 1983) to obtain an initial BW for the experiment. Steers were blocked by BW, stratified by BW within blocks, and randomly assigned to 1 of 30 pens (5 pens/treatment). Pens were blocked by size (8, 10, or 13 steers) and were randomly assigned to 1 of the 6 treatments. All pens were fed to allow for 0.36 m of bunk space per steer. Steers were vaccinated against viral pathogens using modified-live cultures of bovine rhinotracheitis virus, bovine viral diarrhea virus (types 1 and 2), parainfluenza-3 virus, and bovine respiratory syncytial virus (Titanium 5, AgriLabs, St. Joseph, MO) and clostridial bacteria including *Clostridium chauvoei*, *septicum*, *novyi*, *sordellii*, and *perfringens* types C and D (Vision 7 with SPUR, Merck Animal Health, De Soto, KS). All steers were treated against internal (Safe-Guard, Merck Animal Health) and external parasites (UltraSabor, Merck Animal Health) and implanted with 200 mg trenbolone acetate and 40 mg estradiol (Revalor-XS, Merck Animal Health).

Steers receiving the traditional step-up adaptation treatment (**CON**) were adapted from an initial diet containing 45% ALF, 32.5% steam-flaked corn (**SFC**), 20% Sweet Bran, and 2.5% supplement to the final finishing diet containing 65.7% SFC, 20% Sweet Bran, 8% ALF, 3.3% supplement, and 3% yellow grease over a 22-d period. During the step-up period, ALF was reduced and SFC, yellow grease, and urea were increased in 4 step-up diets fed for 5, 5, 6, and 6 d, respectively (Table 1). Steers assigned to RAMP treatments were adapted to the same final finishing diet as the CON treatment using RAMP fed for 14, 18, 22, 26, or 30 d (Table 2). During adaptation for steers fed RAMP, dietary level of RAMP was reduced and the finishing diet was increased. Steers were adapted to the finishing diet in 4 steps according to the following number of days on steps 1 to 4, respectively: 3, 3, 4, and 4, 14-d adaptation; 4, 4, 5, and 5, 18-d adaptation; 5, 5, 6, and 6, 22-d adaptation; 6, 6, 7, and 7, 26-d adaptation; 7, 7, 8, and 8, 30-d adaptation. Upon initiation of the experiment, feed was offered at 2.0% of BW (DM basis) for all dietary treatments. On d 2 of the experiment, DM feed offerings were increased as much as 1.4 kg per steer until ad libitum consumption was achieved. Feed bunks were

Table 2. RAMP[1]-based adaptation diets fed to steers adapted to a finishing diet containing 20% Sweet Bran[2]

Item	Step 1	Step 2	Step 3	Step 4	Finisher
Ingredient, %					
RAMP	100.00	74.99	50.00	24.99	0.00
Steam-flaked corn	0.00	16.50	33.00	49.50	65.70
Sweet Bran[3]	0.00	5.00	10.00	15.00	20.00
Alfalfa hay	0.00	2.00	4.00	6.00	8.00
Yellow grease	0.00	0.75	1.50	2.25	3.00
Limestone	0.00	0.37	0.72	1.09	1.45
Urea	0.00	0.13	0.25	0.38	0.80
Supplement[4]	0.00	0.26	0.53	0.79	1.05
Chemical composition, %					
CP	20.10	18.28	16.43	14.60	13.26
NDF	38.60	33.32	28.06	22.78	16.85
ADF	18.00	15.53	13.06	10.58	8.05
Crude fat	2.80	3.44	4.08	4.72	4.97
Ca	1.06	0.98	0.90	0.83	0.74
P	0.90	0.76	0.62	0.49	0.33

[1]RAMP = a complete starter feed (Cargill Corn Milling, Blair, NE) consisting of wet corn gluten feed, cottonseed hulls, alfalfa hay, minerals, and vitamins.

[2]Steers were adapted in 14, 18, 22, 26, or 30 d and consumed steps 1 through 4 for varying number of days according to the following schedule: 3, 3, 4, and 4, 14-d adaptation; 4, 4, 5, and 5, 18-d adaptation; 5, 5, 6, and 6, 22-d adaptation; 6, 6, 7, and 7, 26-d adaptation; 7, 7, 8, and 8, 30-d adaptation.

[3]Sweet Bran is a branded wet corn gluten feed product (Cargill Corn Milling).

[4]Formulated to provide a dietary DM inclusion of 0.30% salt, 60 mg/kg Fe, 40 mg/kg Zn, 30 mg/kg Mg, 25 mg/kg Mn, 10 mg/kg Cu, 1 mg/kg I, 0.15 mg/kg Co, 0.10 mg/kg Se, 1.5 IU/g vitamin A, 0.15 IU/g vitamin D, 8.81 IU/kg vitamin E, 33 mg/kg monensin, and 8.7 mg/kg tylosin.

evaluated daily at 0630 h, and feed was allotted such that approximately 30 g per steer remained in the bunk each morning. Diets were mixed and delivered once daily throughout the duration of the experiment.

Steers were weighed via pen scale on d 36, 84, and the day of harvest and a 4% shrink was applied to calculate shrunk BW (NRC, 1996). Steers were marketed in 4 weight blocks when the average fat thickness of each block was visually estimated to be 1.27 cm. On the day of harvest, feed was withheld and steers were pen-weighed. Cattle were transported approximately 40 km to a federally inspected commercial facility (Tyson Fresh Meats, Inc., Amarillo, TX) for harvest and subsequent carcass data collection (West Texas A&M University Beef Carcass Research Center, Canyon, TX). Hot carcass weights and liver scores were recorded on the day of harvest, whereas 12th-rib fat thickness, LM area, and called marbling score were recorded following a 48-h chill. Liver abscesses were categorized as A−, A, A+, A+AD, and A+OP according to the procedures of Brown and Lawrence (2010). The liver abscess categories were then combined to calculate the proportion of steers with abscessed livers in each pen. Yield grade was calculated using carcass measurements (USDA, 1997). Live performance calculations were made using shrunk final BW, whereas carcass-adjusted final BW, ADG, and G:F were calculated using HCW and an average DP of 63.7.

Steam-flaked corn (348 g/L [27 pounds/bushel]) was purchased 3 to 4 times a week from a local feedlot. Sweet Bran and RAMP were stored in an open-front commodity shed and were delivered to the feedlot every 10 to 14 d, as needed. Throughout the experiment, when wet, stale, or excessive feed remained in the bunk, orts were weighed and a subsample was collected for DM determination. Orts were subtracted from feed offered (DM basis) to calculate DMI. The calculated DMI was multiplied by the dietary inclusion of ALF to determine ALF usage during the adaptation phase, the finishing phase, and across the entire experiment. Ingredient samples were collected thrice weekly for high-energy ingredients (SFC, RAMP, and Sweet Bran) and once weekly for all other ingredients for DM determination. Ingredient DM was determined by drying in a 60°C oven for 48 h (AOAC, 1999) and was updated weekly for ration formulation. A composite sample was made for each ingredient using DM samples collected over the duration of the experiment and sent to a commercial laboratory (Servi-Tech Laboratories, Amarillo, TX) for analysis of CP, NDF, ADF, crude fat, Ca, and P.

Data were analyzed as a randomized complete block design using the mixed model procedures (PROC MIXED) of SAS version 9.2 (SAS Institute Inc., Cary, NC) with pen serving as the experimental unit. The model included treatment as a fixed effect and block as a random effect. Preplanned contrasts were developed to compare the average of RAMP treatments vs. the CON treatment, as well as the linear and quadratic effects of adapting steers using RAMP. A PDIFF statement was used to separate treatment means. Standard errors of treatment differences are reported due to the inclusion of block as a random variable (Galyean, 2009). Percentage of steers with liver abscesses was analyzed using the GLIMMIX procedure of SAS with a logit link function and a binomial distribution. The model remained the same as previously described. Effects were considered significant when $P \leq 0.05$, and tendencies were declared when P-values were between 0.05 and 0.10.

RESULTS AND DISCUSSION

During the course of the experiment, 7 steers died or were removed from the experiment. These 7 steers

Table 3. Interim performance characteristics of steers adapted to a finishing diet using a traditional adaptation program for 22 d or RAMP[1] for 14 to 30 d

	CON[2]	RAMP[3]						*P*-value[4]			
Item	22	14	18	22	26	30	SE	RAMP	LIN	QUAD	*F*-test
Pens	5	5	5	5	5	5	—	—	—	—	—
Initial BW, kg	319	319	320	319	319	319	0.5	0.36	0.94	0.48	0.49
36-d performance											
BW, kg	390[c]	394[b]	399[a]	395[ab]	394[b]	398[ab]	3	0.01	0.56	0.94	0.05
DMI, kg/d	9.26	9.43	9.70	9.46	9.76	9.83	0.29	0.10	0.20	0.86	0.34
ADG, kg	1.97[b]	2.08[ab]	2.20[a]	2.11[a]	2.07[ab]	2.19[a]	0.07	0.01	0.55	0.85	0.05
G:F, kg/kg	0.215	0.221	0.227	0.224	0.214	0.223	0.006	0.12	0.53	0.95	0.20
84-d performance											
BW, kg	495[c]	498[bc]	510[a]	502[b]	504[ab]	504[ab]	4	0.02	0.50	0.17	0.03
DMI, kg/d	10.4	10.5	10.8	10.6	10.9	10.8	0.2	0.07	0.18	0.67	0.16
ADG, kg	2.10[c]	2.13[bc]	2.26[a]	2.18[b]	2.21[ab]	2.20[ab]	0.04	0.01	0.49	0.17	0.03
G:F, kg/kg	0.203	0.204	0.210	0.208	0.203	0.205	0.004	0.37	0.54	0.28	0.40

[a–c]Means within row with unlike superscripts differ ($P \leq 0.10$) when *F*-test is significant ($P \leq 0.05$).

[1]RAMP = a complete starter feed (Cargill Corn Milling, Blair, NE) consisting of wet corn gluten feed, cottonseed hulls, alfalfa hay, minerals, and vitamins.

[2]CON = steers adapted to a finishing diet using traditional step-up adaptation method over 22 d.

[3]Steers adapted to a finishing diet using RAMP for 14, 18, 22, 26, or 30 d.

[4]Contrasts: RAMP = CON vs. average of all RAMP treatments; LIN = linear effect of days to finisher for treatments receiving RAMP; QUAD = quadratic effect of days to finisher for treatments receiving RAMP; *F*-test = overall *F*-test representing variation due to treatment.

were not included in final analysis of performance and carcass data. The loss of steers from the experiment was not related to treatment, as 4 of the 6 treatments lost steers, including the CON. The 4 weight blocks were marketed after 112, 126, 140, and 161 d on feed, and average days on feed across all pens was 140 d.

After 36 d on feed, steers consuming RAMP exhibited greater ADG than CON steers (1.97 vs. 2.13 kg, CON and RAMP, respectively; $P = 0.01$; Table 3), which resulted in increased BW (390 vs. 396 kg, CON and RAMP, respectively; $P = 0.01$). Steers adapted to the finishing diet using RAMP tended to consume 4% more feed than CON ($P = 0.10$). Efficiency of gain was similar ($P = 0.12$) between CON and RAMP treatments. The use of RAMP improved steer ADG and BW after 36 d on feed. However, the length of adaptation with RAMP (14 to 30 d) had no effect ($P \geq 0.20$) on animal performance after 36 d.

Similar performance responses were observed after 84 d on feed (Table 3). Compared with CON, steers which were adapted to the finishing diet using RAMP gained 9 kg of additional BW ($P = 0.02$) at a greater rate (0.10 kg/d; $P = 0.01$) and tended to consume 0.3 kg/d more feed ($P = 0.07$). Similar to the 36-d performance data, there were no linear or quadratic effects of the number of days steers were adapted to the finishing diet using RAMP ($P \geq 0.17$).

Over the entire experiment, no treatment differences were observed for DMI ($P \geq 0.22$; Table 4). On a live-basis, final BW, ADG, and G:F were not affected by dietary treatment ($P \geq 0.15$). When evaluating performance on a carcass-adjusted basis, the use of RAMP resulted in an additional 13 kg of final BW ($P = 0.05$) and tended to increase ADG by 0.09 kg ($P = 0.06$). The use of RAMP had no effect on G:F when calculated on either a live basis or carcass-adjusted basis ($P \geq 0.25$).

Huls et al. (2009) and Schneider et al. (2012) reported an improvement in G:F when adapting steers to finishing diets using high levels of Sweet Bran or RAMP, respectively. Conversely, we previously reported no difference in G:F when adapting steers to finishing diets using high concentrations of Sweet Bran (MacDonald and Luebbe, 2012), and the current data suggest no difference in G:F with RAMP. The primary difference is the studies of Huls et al. (2009), and Schneider et al. (2012) both used finishing diets consisting of a combination of dry-rolled and high-moisture corn, whereas the experiment of MacDonald and Luebbe (2012) and the current experiment used SFC-based finishing diets with added yellow grease. An improvement in G:F resulting from the use of RAMP may be dependent on the corn processing method, or perhaps caloric density of the finishing diets.

The difference in final BW calculated from live performance and carcass-

Table 4. Final performance characteristics of steers adapted to a finishing diet using a traditional adaptation program for 22 d or RAMP[1] for 14 to 30 d

	CON[2]	RAMP[3]						*P*-value[4]			
Item	22	14	18	22	26	30	SE	RAMP	LIN	QUAD	*F*-test
Pens (steers)	5 (50)	5 (50)	5 (51)	5 (49)	5 (48)	5 (51)	—	—	—	—	—
Days on feed	140	140	140	140	140	140	—	—	—	—	—
DMI, kg/d	10.7	10.7	11.0	10.7	11.1	10.9	0.2	0.22	0.33	0.58	0.27
Live performance											
BW,[5] kg	589	592	604	589	600	594	7	0.19	0.96	0.55	0.16
ADG, kg	1.94	1.97	2.06	1.95	2.02	1.99	0.05	0.15	0.96	0.63	0.17
G:F, kg/kg	0.182	0.184	0.187	0.182	0.182	0.182	0.004	0.65	0.33	0.92	0.75
Carcass-adjusted performance											
BW,[6] kg	584[c]	587[c]	610[a]	591[bc]	601[ab]	594[b]	7	0.05	0.74	0.12	0.03
ADG, kg	1.90[c]	1.92[c]	2.09[a]	1.94[bc]	2.02[ab]	1.98[bc]	0.06	0.06	0.71	0.19	0.04
G:F, kg/kg	0.179	0.180	0.190	0.182	0.182	0.182	0.005	0.25	0.76	0.26	0.27

[a–c]Means within row with unlike superscripts differ ($P \leq 0.10$) when *F*-test is significant ($P \leq 0.05$).

[1]RAMP = a complete starter feed (Cargill Corn Milling, Blair, NE) consisting of wet corn gluten feed, cottonseed hulls, alfalfa hay, minerals, and vitamins.

[2]CON = steers adapted to a finishing diet using traditional step-up adaptation method over 22 d.

[3]Steers adapted to a finishing diet using RAMP for 14, 18, 22, 26, or 30 d.

[4]Contrasts: RAMP = CON vs. average of all RAMP treatments; LIN = linear effect of days to finisher for treatments receiving RAMP; QUAD = quadratic effect of days to finisher for treatments receiving RAMP; *F*-test = overall *F*-test representing variation due to treatment.

[5]Final BW measured live and shrunk 4% (NRC, 1996).

[6]Final BW calculated from HCW using a common dress of 63.7%.

adjusted performance is the result of a numeric difference ($P = 0.11$) in DP between CON and RAMP treatments. Dressing percentage tended ($P = 0.07$; Table 5) to change in a quadratic manner as days of adaptation using RAMP increased with greatest DP occurring when RAMP was fed for 18 d. Dressing percentage and red meat yield increase with adiposity (Abraham et al., 1980), so the increase in DP as a result of RAMP is supported by a linear increase ($P = 0.06$) in fat thickness and an increase in YG ($P = 0.01$) with increasing days fed RAMP. There were no differences in percentage of abscessed livers ($P > 0.50$), LM area ($P \geq 0.12$), or marbling score ($P \geq 0.50$) due to dietary treatment. Previously we observed an increase in marbling score when feeding high levels of Sweet Bran during grain adaptation (MacDonald and Luebbe, 2012). These data do not appear to support an improvement in marbling when adapting cattle to a finishing diet using RAMP.

The use of RAMP resulted in an 8 kg increase in HCW ($P = 0.05$) compared with the CON treatment. We previously reported an 8 kg increase in HCW when adapting steers to finishing diets using Sweet Bran and 8% ALF (MacDonald and Luebbe, 2012). Similarly, Huls et al. (2009) reported a 7 kg increase in HCW when adapting steers to finishing diets using Sweet Bran and 15% corn silage. Schneider et al. (2012) reported a 7 kg numeric ($P = 0.13$) increase in HCW for steers adapted using RAMP. Within the context of the limited number of experiments (4) which utilized Sweet Bran or RAMP to adapt steers to finishing diets, the potential to increase HCW appears to consistently fall within the range of 7 to 8 kg.

The number of days steers were adapted to the finishing diet using RAMP resulted in a numeric ($P = 0.13$) quadratic response for HCW with the greatest HCW observed at 18 d of adaptation. One of the more surprising results of the experiment was the similarity of HCW response for steers adapted to the finishing diet in 22 d using RAMP vs. CON, especially because steers adapted using RAMP for both 18 and 26 d had significantly greater HCW than CON ($P \leq 0.04$). If the HCW for steers adapted using RAMP for 22 d had been greater, the quadratic term likely would have had greater significance. The 18- and 22-d RAMP steers were not different after 36 or 84 d on feed ($P > 0.05$; Table 3). Yet the numeric difference in BW between 18 and 22 d RAMP treatments increased during this time and the final carcass-adjusted final BW was greater for steers adapted with RAMP for 18 d compared with steers adapted with RAMP for 22 d ($P < 0.05$; Table 4).

Table 5. Carcass characteristics of steers adapted to a finishing diet using a traditional adaptation program for 22 d or RAMP[1] for 14 to 30 d

	CON[2]	RAMP[3]						*P*-value[4]			
Item	22	14	18	22	26	30	SE	RAMP	LIN	QUAD	*F*-test
HCW, kg	372[c]	374[c]	388[a]	376[bc]	383[ab]	378[bc]	5	0.05	0.74	0.13	0.03
Dressing percentage	63.3	63.2	64.3	64.0	63.8	63.8	0.4	0.11	0.47	0.07	0.12
12th-rib fat thickness, cm	1.10	1.20	1.16	1.20	1.32	1.30	0.08	0.04	0.06	0.56	0.11
LM area, cm^2	90.1	90.6	95.4	89.9	91.1	89.0	2.0	0.48	0.12	0.20	0.07
Marbling score[5]	506	500	492	502	496	494	17	0.50	0.84	0.93	0.96
YG[6]	2.62	2.71	2.58	2.75	2.88	2.94	0.13	0.14	0.01	0.34	0.06
Abscessed livers,[7] %	11.8	12.0	9.8	0.0	6.1	10.2	4.6	0.97	0.56	0.97	0.94

[a–c]Means within row with unlike superscripts differ ($P \le 0.10$) when *F*-test is significant ($P \le 0.05$).

[1]RAMP = a complete starter feed (Cargill Corn Milling, Blair, NE) consisting of wet corn gluten feed, cottonseed hulls, alfalfa hay, minerals, and vitamins.

[2]CON = steers adapted to a finishing diet using traditional step-up adaptation method over 22 d.

[3]Steers adapted to a finishing diet using RAMP for 14, 18, 22, 26, or 30 d.

[4]Contrasts: RAMP = CON vs. average of all RAMP treatments; LIN = linear effect of days to finisher for treatments receiving RAMP; QUAD = quadratic effect of days to finisher for treatments receiving RAMP; *F*-test = overall *F*-test representing variation due to treatment.

[5]400 = Slight 0; 500 = Small 0.

[6]Calculated as YG = 2.50 + (6.35 × fat depth, cm) − (2.06 × LM area, cm^2) + (0.2 × KPH, %) + (0.0017 × HCW, kg).

[7]Includes livers with abscess scores of A−, A, A+, A+AD, and A+OP (Brown and Lawrence, 2010). The most conservative SE is provided.

The reasons for these observations are unclear and are difficult to explain. A close evaluation of the daily DM feed offerings during the adaptation period suggests that steers adapted with RAMP for 18 d had greater DMI during d 11 to 15 of the adaptation period (data not shown), which may have enhanced their energy intake during this time. As previously noted, research in which steers were adapted with Sweet Bran indicated that the performance response may be related to differences in energy intake early in the feeding period (MacDonald and Luebbe, 2012). Although anecdotal at best, this observation may suggest that the opportunity to gain a performance response from using RAMP may be achieved by maximizing intake during the adaptation period more so than from optimizing the number of days RAMP is fed. Nevertheless, the HCW of steers consuming RAMP during grain adaptation was equal to or greater than CON in all cases.

The use of RAMP had a dramatic impact on the amount of ALF required during the adaptation period (Table 6). The amount of ALF consumed by steers fed RAMP during adaptation was 7.6 to 18.3% of the amount of ALF consumed by CON steers during adaptation ($P < 0.01$). Additionally, the greater number of days steers were fed RAMP, the more ALF they consumed during the adaptation period (linear term, $P < 0.01$). We calculated ALF consumption for the adaptation period (different number of days for different treatments) and finishing period (different days due to adaptation treatments). Therefore, steers that were adapted with RAMP for 30 d consumed more ALF during adaptation compared with steers adapted with RAMP for 14 d. The number of adaptation days explains the linear effect of days of adaptation for steers fed RAMP. Conversely, steers adapted with RAMP consumed more ALF while consuming the same finishing diet ($P < 0.01$). The greater number of days steers were fed RAMP during adaptation, the less ALF they consumed during the finishing phase (linear term, $P < 0.01$). Total ALF use during the feeding period was reduced by 21 to 28% as a result of using RAMP ($P < 0.01$). Total ALF use declined linearly with increasing days of RAMP use ($P < 0.01$). The potential to reduce forage use is attractive to large commercial feedlots because forage is typically expensive per unit of energy and is difficult to store and handle in enclosed mills. Additionally, limitations to water availability in the Southern Plains in the future may limit forage availability in this region. Using RAMP appears to be a viable strategy for reducing roughage requirements in feedlots in the Southern Plains.

IMPLICATIONS

Although short in duration, grain adaptation is an important phase of the feeding period because it can have great effects on subsequent animal performance. Animal performance can be improved by maximizing energy intake during this time as long as ruminal acidosis is minimized. The use of RAMP appears to be effective in

Table 6. Alfalfa hay use by steers adapted to a finishing diet using a traditional adaptation program for 22 d or RAMP[1] for 14 to 30 d

	CON[2]	RAMP[3]						*P*-value[4]			
Item	22	14	18	22	26	30	SE	RAMP	LIN	QUAD	*F*-test
Alfalfa hay use, kg/steer											
Adaptation diet[5]	55^{a}	4^{e}	6^{de}	7^{cd}	8^{bc}	10^{b}	1	<0.01	<0.01	0.98	<0.01
Finishing diets	94^{c}	110^{a}	109^{a}	103^{b}	104^{b}	98^{c}	2	<0.01	<0.01	0.58	<0.01
Total	149^{a}	114^{b}	115^{b}	110^{bc}	112^{bc}	108^{c}	3	<0.01	0.03	0.66	<0.01
Reduction in use, %	—	23.5	22.8	26.2	24.8	27.5	—	—	—	—	—

[a–e]Means within row with unlike superscripts differ ($P \leq 0.10$) when *F*-test is significant ($P \leq 0.05$).

[1]RAMP = a complete starter feed (Cargill Corn Milling, Blair, NE) consisting of wet corn gluten feed, cottonseed hulls, alfalfa hay, minerals, and vitamins.

[2]CON = steers adapted to a finishing diet using traditional step-up adaptation method over 22 d.

[3]Steers adapted to a finishing diet using RAMP for 14, 18, 22, 26, or 30 d.

[4]Contrasts: RAMP = CON vs. average of all RAMP treatments; LIN = linear effect of days to finisher for treatments receiving RAMP; QUAD = quadratic effect of days to finisher for treatments receiving RAMP; *F*-test = overall *F*-test representing variation due to treatment.

[5]Alfalfa use is influenced by number of days of adaptation and RAMP use.

increasing energy intake during grain adaptation perhaps because the ruminal fermentation substrate it provides more closely resembles forage but the energy concentration contained in RAMP more closely resembles cereal grain. The reduction in roughage requirements and improvements in feedmill efficiency may provide additional benefits to feedyards in the Southern Plains.

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