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Health of Finishing Steers: Effects on Performance, Carcass Traits and Meat Tenderness

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Story in Brief

The impact of respiratory disease during a 150-d feedlot finishing period on daily gain, carcass traits, and *longissimus* tenderness was measured using 204 steer calves. Feedlot health status was monitored two ways. First, clinical signs of respiratory infection were evaluated each day with medication based on degree of fever (body temperature). Steers that were medicated (n = 102) had lower final live weights, ADG, hot carcass weights (HCW), less external and internal fat, and more desirable YG. Morbid steers yielded more U.S. Standard carcasses than steers that were never treated. Secondly, at the processing plant, each lung was evaluated by a lesion classification system that included presence or absence of bronchial lesions in the anterioventral lobes plus activity of the bronchial lymph nodes (non-active versus active). Lung lesions, present in 33% of all lungs, were distributed almost equally between medicated (37%) and non-medicated groups (29%). Steers with lesions (n = 87) had lower ADG, lighter HCW, less internal fat, and lower marbling scores than steers without lesions. Compared with steers with lesions but non-active lymph nodes (n = 78), steers with active bronchial lymph nodes had lower ADG and dressing percentage. *Longissimus* shear force values were lower for steaks aged 7-d from steers without than those from steers with lung lesions. Overall, respiratory morbidity suppressed daily gains and increased the percentage of U.S. Standard carcasses. Classification of health status by respiratory tract lesions plus bronchial lymph node activity at harvest was more predictive of adverse effects of respiratory health on production, carcass trait, and meat tenderness differences than clinical appraisal and elevated body temperature.

(Key Words: Health, Morbidity, Performance, Carcass Traits, Tenderness.)

Introduction

Commonly referred to as BRD, the bovine respiratory disease complex is responsible for 75% of the morbidity and over 50% of feedlot mortality (Edwards, 1996). Diseases of the respiratory system, most prevalent among newly arrived feeder cattle, account for some 90% of all clinical treatments during the first 4 to 5 wk at the feedyard (Martin and Lumsden, 1987), but BRD may recur throughout the finishing phase (Edwards, 1988; Martin et al., 1982).

Several researchers have suggested that feedlot health impacts performance and may affect carcass quality. In the Texas A&M Ranch-to-Rail program (McNeill et al., 1996), non-treated steers had 5% greater ADG during the finishing period (2.93 vs 2.78 lb) and yielded 12% more U.S. Choice carcasses than those steers treated for health complications. The relationship between the clinical evaluations of BRD in the feedlot environment and the presence of an infectious respiratory process is equivocal at best. Consequently, research documenting the effects of feedlot health on performance, carcass characteristics, and meat quality is difficult. Examination of lungs at the time of harvest may help define the existence of prior respiratory events more precisely. Our objectives were to evaluate the effects of health, evaluated using 1) clinical appraisal and elevated body temperature and 2) respiratory tract lesions plus bronchial lymph node activity at harvest, to feedlot performance, carcass characteristics, and meat tenderness.

Materials and Methods

Feedlot Performance. Charolais steer calves (n = 222) from a single herd were transported to a

commercial feeding facility in southwestern Kansas. Upon arrival, each steer was weighed, vaccinated and dewormed, implanted with 20 mg estradiol benzoate plus 200 mg progesterone, and identified with both an electronic identification tag and a numbered ear tag. Animals were placed in a single pen and fed a high concentrate ration. On d 82 of the feeding period, steers were reimplanted with 120 mg trenbolone acetate plus 24 mg estradiol benzoate. Individual weights of steers were obtained on d 137 of the feeding period. On d 150, 108 steers were transported to a commercial packing facility for harvest; the remaining steers (107) were harvested on d 151. Feedlot daily gain was calculated from individual animal weights collected on d 1 (assumed to be a shrunk weight) and on d 137 (assuming a 4% gut fill) of the feeding period. Dressing percentage was calculated by dividing hot carcass weight (on d 150 or 151) by unshrunk weight obtained on d 137.

Health Evaluation. During the total finishing phase, steers were monitored daily for clinical signs of respiratory infection. Rectal temperatures were obtained from each animal exhibiting respiratory complications. Sick steers, treated using a pre-determined protocol developed by the consulting veterinarian, were maintained at the hospital pen for a minimum of 3-d.

Respiratory Tract Lesions. At harvest, lungs were evaluated by a lesion classification system; lungs were evaluated for the presence of bronchopneumonia lesions in the anterioventral lung lobes as well as lymph node activity (non-active vs active) based on the size of the bronchial lymph nodes. Each lesioned lung was classified as non-active or active depending on the activity of lung lymph nodes. Lesions from lungs with non-active lymph nodes presumably reflected previous case of BRD or reflected a lesion that was less severe and resolved more rapidly than lesions from lungs with active lymph nodes.

Carcass Characteristics and Tenderness Assessment. Carcasses were chilled at 0^{o}C for approximately 36 h, after which USDA quality and yield grade (USDA, 1989) carcass measurements were collected. The ribeye (10th through 12th rib) lip-on (IMPS 112A; USDA, 1988) was fabricated from the left side of each carcass, vacuum packaged, and transported to Wichita, KS where samples were aged for 5-d at 2^{o}C. Two 1-in thick steaks obtained from each ribeye were vacuum packaged, and aged at 2^{o}C for either 7- or 14-d. At the end of each assigned aging period, appropriate steaks were boxed, blast frozen, and maintained at -40^{o}C. Upon completion of the aging period, each steak was assigned randomly to one of eight cooking days. Twenty-four hours prior to cooking, appropriate steaks were placed on metal trays, the vacuum was released, and steaks were tempered at 4^{o}C. Steaks were broiled at 177^{o}C in an impingement oven to a final internal temperature of 70^{o}C. After steaks were cooled to 25^{o}C, six cores (0.5 in diameter) were removed parallel to the longitudinal direction of the muscle fibers and shear force values were obtained for each steak using a Warner-Bratzler attachment to an Instron Universal Testing Machine.

Statistical Analysis. Data were analyzed separately for the effects of respiratory health evaluations and the classification of respiratory tract lesions at harvest using least squares procedures (SAS, 1985). Contrasts were used to assess differences between non-treated versus all treated cattle as well as to compare those treated once versus those treated more than once. Steers that had lungs without lesions were contrasted to those with lesions; further, those having lesioned lungs but non-active bronchial lymph nodes were compared with those with lesions plus active bronchial lymph nodes. Probability values reported were generated by SAS (1985). The total data set consisted of 204 cattle for which complete health and carcass data were collected.

Results and Discussion

Mean initial live weight for the steers was 642 lb (range = 505 to 1014 lb); mean weight on d 137 was 1140 lb (871 to 1340 lb) for an average daily gain of 3.31 lb/d (1.57 to 4.59 lb). Dressing percentage was at the industry average (63.5%) when calculated using the unshrunk individual weight collected on d 137 but ranged from 57.7 to 68.2%. Mean adjusted fat thickness was .44 inch, indicating that, on average, cattle were extremely lean. As a result of being trim both externally and internally and being heavy muscled, mean yield grade was 2.6.

Even though marbling score ranged from traces to modest, mean marbling score was 36 percentage points into the slight marbling category. However, despite this low mean quality grade (U.S. Select), Warner-Bratzler shear force values were quite low after only 7-d of postmortem aging.

Performance Traits.

Health Evaluation. The effects of clinical appraisal and elevated temperature on cattle performance and carcass attributes are presented in Table 1. Exactly 50% of the steers were treated for respiratory disease at some time during the finishing period. Although initial weights of steers used were not different ($P=.59$), steers clinically diagnosed with BRD during the finishing phase (Table 1) had 4% lower ($P<.02$) ADG than non-treated steers (3.24 vs 3.36 lb/d). This resulted in 16.5 lb lower ($P<.01$) carcass weights for the treated steers.

Comparing steers treated for BRD once with those treated more than once, final weights did not differ ($P=.21$), but steers that had been treated once gained faster ($P<.04$) than those treated more than once (Table 1). Regression analysis revealed that total gain was reduced by 14.8 lb ($P=.002$) for each day a steer was held in the hospital for treatment of BRD. This reduced daily gain of treated steers may be a result of decreased feed consumption. Although feed intake of individual animals was not collected in our trial, Sowell et al. (1997) reported that steers treated for clinical health symptoms spent 23% less time eating and made fewer trips to the feedbunk during a 32-d receiving period.

Respiratory Tract Lesions. Among the steers never diagnosed as being sick during the trial, 37.2% had lung lesions of which 9% had active bronchial lymph nodes. Among steers diagnosed as sick at some time during the study, 48.1% had lung lesions of which 14% had active bronchial lymph nodes. The high lung lesion incidence in steers never diagnosed as having BRD indicates that 1) lung damage occurred during a respiratory infection that was not detected externally by feedlot personnel or 2) BRD occurred prior to the finishing phase and resulted in permanent bovine lung lesions even after the cattle recovered from the overt disease. The fact that 52% of the cattle treated for BRD had no lung lesions reflects either 1) imprecise clinical diagnosis or 2) full recovery from previous lung lesions.

The effects of lung lesions on performance and carcass traits are presented in Table 2. Initial steer weights were heavier for cattle detected with lung lesions ($P<.03$) as well as for those with active vs non-active bronchial lymph nodes ($P<.01$). However, cattle without lesions at harvest had the heaviest final live weights ($P<.01$) as a result of 12% (3.48 vs 3.08 lb) greater ($P<.01$) ADG than cattle with lesions. Steers with active bronchial lymph nodes had 18% (2.58 vs 3.14 lb) lower ($P<.01$) ADG than steers with non-active bronchial lymph nodes. These results indicate that cattle recovering from BRD never compensated for lost performance.

Carcass Traits.

Health Evaluation. Values for carcass traits are shown in Tables 1 and 2. Dressing percentage did not differ between non-treated vs treated steers ($P=.31$); however, as a result of lighter final live weights (Table 1), steers treated for BRD had 2% (16.5 lb) lighter carcasses ($P<.01$). Carcasses from non-medicated steers were fatter both externally ($P<.01$) as well as internally ($P<.05$) and tended to have larger ribeye areas ($P=.12$) than carcasses from medicated steers. Consequently, steers not treated for BRD during the finishing period had higher ($P<.04$) U.S. yield grades than treated steers; ribeye area/100 lb hot carcass weight did not differ ($P=.28$) between the two groups. Marbling score appeared to be affected slightly by clinical health; non-medicated steers had slightly higher mean marbling scores than medicated steers (Slight^{38} vs Slight^{34}; $P=.16$), which resulted in slightly higher percentages of U.S. Choice and U.S. Select carcasses for non-medicated steers and more U.S. Standard carcasses from steers medicated for BRD.

Differences in carcass traits between steers treated for BRD once versus those treated more than once resembled differences between non-treated versus treated steers. Steers treated only once had a higher ($P<.07$) dressing percentage and yielded heavier carcasses ($P<.07$) that were fatter

externally ($P<.01$) and internally ($P<.01$) than steers treated more than once. Because their carcasses were lighter and leaner, steers treated more than once had more desirable ($P=.07$) yield grades than those treated only once. This yield grade difference may be attributed partly to the greater mean carcass weight of the steers treated only once for BRD. No differences ($P=.30$) in ribeye area were detected between steers treated once and those treated more than once. Although not statistically significant, cattle treated more than once tended ($P=.15$) to have lower marbling scores than those treated only once. This difference in mean marbling score resulted in steers treated more than once having the highest percentage of U.S. Standard carcasses.

Respiratory Tract Lesions. Steers with lung lesions had a lower ($P=.02$) dressing percentage than those steers without lesions. Contrasts between non-affected and lesioned lungs revealed that carcasses from steers without lesions at slaughter were heavier ($P<.01$), had more external fat ($P=.13$), larger ribeye areas ($P=.15$) but smaller ribeye area/100 lb hot carcass weight ($P=.02$), and more kidney, pelvic, and heart fat ($P<.01$) than steers with lesioned lungs. Non-active bronchial lymph node vs active bronchial lymph node differences were noted for dressing percentage ($P<.01$), hot carcass weight ($P=.11$), and ribeye area/100 lb hot carcass weight ($P=.02$). Carcasses from steers without lesions had a higher ($P<.01$) degree of marbling than those from steers with lesions, while steers with lesions and no bronchial lymph node activity tended ($P<.06$) to have more marbling than those with lesions and active lymph nodes. Steers that had lungs with active lymph nodes produced a higher percentage of U.S. Standard carcasses at the expense of U.S. Choice and U.S. Select carcasses. Differences in yield grade were less dramatic than those observed for quality grade.

Longissimus Properties. No differences in shear force values for steaks aged 7- or 14-d were detected for steers classified clinically (Table 3). However, a difference ($P<.06$) in shear force for steaks (aged 7-d) was detected; steaks from steers without lesions were more tender than steaks from steers with lung lesions (Table 4). Differences in shear force may be accounted for by the difference in marbling score. Beyond 7-d of postmortem aging, differences in shear force were not detected ($P>.15$). All steaks had shear force values that were quite low.

Implications

Respiratory morbidity depressed performance of beef steers, reducing carcass weight, fat deposition, and ribeye area. Performance traits were correlated more closely to lung lesions at harvest than evaluation of disease in the sick animal by clinical appraisal and elevated body temperature. The presence of lung lesions, especially when combined with bronchial lymph node activity, markedly depressed performance and carcass quality, but clinically determined morbidity did not decrease tenderness. *Longissimus* steaks from steers that had lung lesions had higher shear force values after 7-d postmortem age, but shear force did not differ for steaks that had been aged at least 14-d. The high lung lesion incidence (37%) present in steers never diagnosed as having BRD indicates that 1) respiratory infections were not detected by feedlot personnel or 2) BRD occurred before cattle entered the feedlot. The imprecision of clinical diagnosis of BRD strengthens the argument for mass medication.

Literature Cited

Edwards, A.J. 1996. Bovine Pract. 30:5.

Edwards, A.J. 1988. Bovine Pract. 23:47.

Martin, S.W. et al. 1982. Can. J. Comp. Med. 46:341.

Martin, W.W. and J.H. Lumsden. 1987. Can J. Vet. Res. 51:499.

McNeill, J.W. et al. 1996. J. Anim. Sci. 74(Suppl 1):135.

SAS. 1985. SAS/STATâ User s Guide. SAS Inst. Inc., Cary, NC.

Sowell, B.F. et al. 1997. Proc. SW Nutr. and Mgmnt. Conf. Phoenix, AZ.

USDA. 1988. Agric. Mktg. Serv., USDA, Washington, DC.

USDA. 1989. Agric. Mktg. Serv., USDA, Washington, DC.

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Table 1. Performance and carcass traits of steers treated for BRD.

	Times treated for BRD				Contrasts[a]	
Trait	0	1	>1	SE	0 vs P	1 vs >1
Number of steers	102	89	13			
Initial weight, lb	646	634	646	5.23	.59	.52
Weight d 137, lb	1153	1131	1098	7.19	.01	.21
ADG[b], lb/d	3.36	3.30	2.97	.04	.01	.04
Dressing percentage	63.5	63.7	62.6	.35	.31	.06
Hot carcass wt, lb	732	720	687	4.80	.01	.06
Fat tk, in	.35	.32	.21	.06	.001	.004
Adj. fat tk, in	.46	.43	.30	.06	.001	.001
Ribeye area, in^2	13.3	13.2	12.8	1.46	.18	.30
REA/100 lb HCW	1.82	1.83	1.88	.41	.28	.39
KPH, %	2.3	2.3	1.9	.07	.04	.002
Yield grade	2.6	2.6	2.2	.11	.03	.07
Overall maturity[c]	A41	A40	A40	2.61	.67	.87
Marbling score[d]	Sl38	Sl36	Sl18	7.23	.16	.15
Quality grade						
Choice, %	4.9	4.5	.0	3.73		
Select, %	82.4	83.2	76.9	6.93		
Standard, %	12.8	12.4	23.1	6.15		

a Contrasts: 0 vs P=steers never medicated vs all medicated steers; 1 vs >1 = steers treated once vs steers treated more than once.

b ADG was calculated after a 4% pencil shrink was applied to steer weight obtained on d 137.

c Maturity score: "A", between 9 and 30 mo of age.

d Marbling score: Sl = "slightoo", the minimum required for U.S. Select.

Table 2. Performance and carcass traits of steers with or without respiratory tract lesions.

	Respiratory lesion[a]					
		Non-			Contrasts[b]	
Trait	None	active	Active	SE	N vs L	NA vs A
Number of steers	117	78	9			
Initial weight, lb	638	639	694	6.00	.02	.01
Weight d 137, lb	1161	1114	1092	8.06	.001	.46
ADG[c], lb/day	3.48	3.14	2.58	.04	.001	.001
Dressing percentage	63.6	63.6	61.8	.40	.02	.01
Hot carcass wt, lb	738	709	677	5.44	.001	.11
Fat tk, in	.34	.31	.29	.07	.14	.71
Adj. fat tk, in	.45	.42	.41	.08	.13	.89
Ribeye area, in^2	13.4	12.9	13.2	1.68	.15	.53
REA/100 lb HCW	1.82	1.83	1.96	.47	.02	.02
KPH, %	2.3	2.2	2.0	.08	.002	.20
Yield grade	2.6	2.5	2.4	.12	.21	.51
Overall maturity[d]	A41	A40	A40	2.61	.67	.87
Marbling score[e]	Sl40	Sl33	Sl03	8.89	.01	.05
Quality grade						
Choice, %	5.1	3.8	.0	4.34		
Select, %	86.3	78.2	66.7	8.00		
Standard, %	8.6	18.0	33.3	7.05		

a Respiratory tract lesion: none = no lung lesions present; non-active = presence of a healed lesion from a previous respiratory infection; active = lesion plus active lymph node, reflecting active respiratory infection.

b Contrasts:

N vs L = steers without lesions versus all with lesions;

NA vs A = steers with non-active lymph nodes versus those with active lymph nodes.
c ADG was calculated after a 4% pencil shrink was applied to individual steer weights obtained on d 137.
d Maturity score: "A", between 9 and 30 mo of age.
e Marbling score: Sl = "slightoo", the minimum required for U.S. Select.

Table 3. Warner-Bratzler shear values for longissimus steaks from steers treated for BRD.

	Times treated for BRD				Contrasts[a]	
Trait	0	1	>1	SE	0 vs P	1 vs >1
Number of steaks	102	89	13			
Shear force, lb						
Aged 7-d	7.94	8.38	8.16	.12	.40	.55
Aged 14-d	6.83	6.83	6.39	.08	.21	.11
< 8.5 lb, %						
Aged 7-d	68.6	59.6	62.2	8.67		
Aged 14-d	89.2	95.5	100.0	4.71		

a Contrasts:
0 vs P = steers never medicated vs all medicated steers;
1 vs >1 = steers treated once vs steers treated more than once.

Table 4. Warner-Bratzler shear values for longissimus steaks from steers stratified by respiratory tract lesions.

	Respiratory tract lesion[a]					
		Non-			Contrasts[b]	
Trait	None	active	Active	SE	N vs L	NA vs A
Number of steaks	117	78	9			
Shear force, lb						
Aged 7-d	8.00	8.34	8.83	.14	.05	.35
Aged 14-d	6.82	6.92	6.99	.10	.51	.86
< 8.5 lb, %						
Aged 7-d	68.4	60.3	55.6	10.17		
Aged 14-d	94.0	89.7	100.0	5.50		

a Respiratory tract lesion: none = no lung lesions present; non-active = presence of a healed lesion from a previous respiratory infection; active = lesion plus active lymph node, reflecting active respiratory infection.

b Contrasts:

N vs L = steers without lesions vs all with lesions;
NA vs A = steers with non-active lymph nodes vs those with active lymph nodes.

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