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Effects of winter stocker growth rate and finishing system on: I. Animal performance and carcass characteristics[1,2]

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ABSTRACT: Angus-crossbred steers (n = 216) were used in a 3-yr study to assess the effects of winter stocker growth rate and finishing system on finishing performance and carcass characteristics. During winter months (December to April) steers were randomly allotted to 3 stocker growth rates: low (0.23 $kg \cdot d^{-1}$), medium (0.45 $kg \cdot d^{-1}$), or high (0.68 $kg \cdot d^{-1}$). Upon completion of the winter phase, steers were randomly allotted within each stocker treatment to a corn silage-concentrate or pasture finishing system. All steers regardless of finishing treatment were finished to an equal-time endpoint to eliminate confounding of treatments with animal age or seasonal factors. Upon completion of the finishing period, steers were slaughtered in 2 groups (one-half of pasture and one-half of feedlot cattle each time) and carcass data were collected. Winter data were analyzed as a completely randomized design, with winter treatment, pen replicate, year, and the winter × year interaction in the model. Finishing performance and carcass data were analyzed in a split-plot design with finishing system in the whole plot, and winter growth rate and winter × finish in the split-plot. Winter treatment mean within finishing replication was the experimental unit, and year was considered a random effect. Winter stocker phase treatments resulted in differences ($P < 0.001$) in final BW, ADG, and ultrasound LM area between all treatments for that phase. Pasture-finished cattle had lower ($P < 0.001$) final BW, ADG, HCW, LM area, fat thickness, KPH, dressing percent, USDA yield grade, and USDA quality grade. Winter stocker treatment influenced ($P < 0.05$) final BW and HCW, with low and medium being less than high. Steers with low stocker gain had greater ($P < 0.05$) finishing ADG. Dressing percent was greater ($P < 0.001$) for high than low, and USDA quality grade was greater ($P < 0.05$) for high than low and medium. Carcass LM area, fat thickness, KPH, and USDA yield grade were not influenced ($P > 0.05$) by winter rate of gain. Cattle on low during winter exhibited compensatory gain during finishing but were unable to catch the high group regarding BW or HCW. The USDA quality grade was greater for high than low or medium. Animal performance during the winter stocker period clearly impacts finishing performance, carcass quality and beef production in both pasture- and feedlot-finishing systems, when cattle were finished to an equal-time endpoint.

Key words: average daily gain, beef, carcass, finishing, pasture, stocker

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INTRODUCTION

Health conscious consumers include lean beef products in their diets. For some, grass-finished beef is preferred to traditional concentrate-finished US beef because it is perceived as more healthful (lean) and environmentally friendly from a production standpoint (low-input production systems). The beef industry iden-

[1]Mention of a trade names, proprietary product, or specific equipment does not constitute a guarantee or warranty by the USDA and does not imply approval to exclusion of other products that may be suitable.

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tified product tenderness as a major problem in 1990 and has made great strides since that time to improve tenderness (National Beef Tenderness Survey, 2005). However, this improvement has been documented within the traditionally produced beef sector and may not translate to improvement within the grass-fed sector.

Environmental variation undoubtedly can have the most significant impact on livestock performance in forage-based production systems, including stocking and pasture-finishing. Fluctuations in temperature and precipitation influence herbage production and quality, maintenance requirements, and intake. Loss of quality herbage availability may dictate animal liquidation at a given time. Feedlot-finishing systems reduce diet variability, provide consistent animal performance and input costs, allow year-round production, and reduce end-product variability.

Drouillard and Kuhl (1999) referred to the high degree of segmentation within the beef industry and stated that various nutritional and management regimens implemented before feedlot finishing could have profound impacts on carcass quality and consumer acceptability. They expressed the need for a more thorough understanding of the interactions among stocker nutrition and management, finishing performance, carcass traits, and consumer acceptability. Better understanding of these interactions would be especially beneficial to grass-fed and smaller scale, feedlot sectors, when consideration is given to their need for animal liquidation based on a slaughter window rather than a physiological endpoint. We present data on the influence of winter performance on the subsequent performance and carcass characteristics of cattle finished on concentrate or pasture. This information sets the stage for presentation of impact of winter performance on meat composition, color, and palatability that will be presented elsewhere.

MATERIALS AND METHODS

Animals and Feeding

All procedures involving animals were approved by the respective institutional Animal Care and Use Committees. During the winter feeding period, all steers were housed on the West Virginia University Livestock Research and Teaching Farm, Morgantown, WV. Feedlot finishing occurred at the Virginia Tech Shenandoah Valley Agricultural Research and Extension Center (**feedlot**), Steeles Tavern, VA, whereas pasture-finishing occurred simultaneously at the WVU Willow Bend Demonstration Farm, Willow Bend, WV. Ultrasound measures for LM area (**ULMA**) were taken on all steers throughout the study on scheduled weigh dates utilizing an Aloka 500 V real-time ultrasound unit equipped with a 17-cm, 3.5-MHz linear array transducer (Aloka Co. Ltd., American Office, Wallingford, CT). Ultrasound images were processed at the National CUP Lab and Technology Center, Ames, IA. Steers received therapeutic levels of antibiotics on an as-needed basis throughout the study. Steers received no growth stimulants during their entire life span.

Winter Period. In mid-November of 2001, 2002, and 2003, 72 head (each year) of spring-born, English, crossbred steer-calves were randomly allotted to 1 of 3 pen replicates and then allotted to 3 pens within replicate. Winter treatments were then randomly allotted to pen within replicate. Treatment diets were fed in bunks and were designed to produce an ADG of 0.23 (low), 0.45 (medium), or 0.68 (high) $kg \cdot h^{-1} \cdot d^{-1}$ based on energy and protein requirements and DMI (NRC, 1996). Treatments were selected as being representative of a typical range in stocker performance on all-forage diets. Diets were formulated to achieve the desired gains without attainment of maximum DMI to ensure that all feed was cleaned up within a 24-h period.

The ingredients utilized included high-quality, tub-ground timothy hay (*Phleum pratense* L.), soybean [*Glycine max* (L.) Merr.)] meal, soybean hull pellets (as needed to increase energy density), and a commercial high calcium (6Ca:1P) mineral mix containing a trace mineral and vitamin package (SSC-377808 Livestock Mineral, Southern States Cooperative Inc., Richmond, VA). Hay was obtained each year from the same supplier in south central Pennsylvania. All hay was produced on 1 farm from contiguous fields. To maximize diet energy from fiber, soybean hulls were utilized as the fiber-based supplemental energy source for the hay (fiber)-based diets. Steers were fed soybean meal, soybean hulls (if included in the diet formulation), and mineral mix in the bunk before hay to prevent sorting and to ensure consumption by all steers. In 2003, due to lower energy content of the timothy hay, soybean hulls were also included in the low gain diet.

Before the finishing phase, the steers were weighed on d 0 of the winter feeding period and every 28 d thereafter. Upon completion of BW data collection for each 28-d period, treatment gains were assessed by pen, and the diet daily DM allotment was adjusted based on the previous 28-d ADG to achieve the desired rate of gain. Compositions of the winter diets are presented in Table 1.

Finish Period. In mid-April of each year before finishing, the steers were randomly allotted within treatment and pen to pasture- or feedlot-finishing treatments. Cattle were then allotted to finishing replicates. Feedlot-finished cattle were group-fed within pen-replication in yr 1 and by individual electronic gates (American Calan Inc., Northwood, NH) within pen-replication in yr 2. Cattle from the winter treatments were commingled within replicate, and no other treatments were applied during the finishing phase. The goal during pasture finishing was to provide high-quality forage at all times and in adequate supply, so not to compromise animal DMI.

Steers were sequence grazed on mixed pasture consisting primarily of bluegrass (*Poa pratensis* L.), or-

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Table 1. Composition of diets used during the winter feeding periods × treatment, DM

Item	Winter gain treatment		
	Low	Medium	High
Ingredient, %			
Timothy hay	90.9	76.7	58.3
Soybean meal	4.7	3.9	3.3
Soybean hulls	3.5	18.6	37.7
6:1 mineral mix	0.9	0.8	0.8
Chemical composition, %			
CP	10.5	11.2	12.1
ADF	41.5	42.8	44.2
NDF	67.4	66.9	65.1
IVDMD	60.6	65.7	72.3

chardgrass (*Dactylis glomerata* L.), tall fescue (*Festuca arundinacea* L.) and white clover (*Trifolium repens* L.), pure strands of triticale (*Triticale hexaploide* L.)/Italian ryegrass (*Lolium multiflorum* Lam.), and regrowth of orchardgrass and alfalfa (*Medicago sativa* L.) hay meadows. The majority of grazing time was spent on mixed pasture. Cattle on pasture were allowed a commercial pasture mineral (Vigortone No. 35S, North American Nutrition Companies Inc., Lewisburg, OH) free choice at all times. Pasture cattle were also allowed a commercial bloat block (Bloat Guard, Sweetlix, Mankato, MN) while grazing hay meadow regrowth containing a high legume content. Before steers were introduced to new paddocks for grazing, herbage samples for nutritive value assessment were collected via hand-clipping. Samples were taken on a diagonal transect within each paddock, with the clip samples taken every 5 steps. Clip samples were dried in a 60°C forced-air drying oven for later nutritional analyses. The pastures contained (DM basis): 18.0% CP, 33.4% ADF, and 56.5% NDF; IVDMD was 81.3%. The feedlot finishing diet consisted of (DM basis): 18.0% corn silage, 76.0% shell corn, 5.6% soybean meal, 0.14% limestone, and 0.23% trace mineralized salt (Champions Choice, Cargill Inc., Minneapolis, MN), and 20,000 IU of vitamin A·head^{-1}·d^{-1}. Step-up diets were utilized to bring the cattle to full feed during the feedlot finishing. Nutritive values for the feedlot diet (DM basis) were 10.5% CP, 6.5% ADF, and 16.8% NDF.

Pasture cattle were de-wormed with eprinomectin (Eprinex, Merial Ltd, Iselin, NJ) and received fly-control treatment via commercial pour-on products (Durasect II, Pfizer Animal Health, Exton, PA; Elector, Elanco Animal Health, Indianapolis, IN) throughout the grazing season. All medicinal slaughter regulations were adhered to.

Animal Slaughter and Carcass Data Collection

All steers were slaughtered at approximately 18 mo of age in 2 groups (one-half of pasture and one-half of feedlot cattle each time) in September of each year. An equal-time endpoint was chosen over a physiological endpoint for several reasons: 1) an equal-time endpoint may be more realistic for forage-finishing and small-scale feedlot-finishing operations, where diet availability often dictates when livestock are sold; 2) a desire to eliminate confounding of treatments with animal age or seasonal factors; 3) because small-scale operations, in most circumstances, must sell livestock at an equal-time endpoint because of economics of scale.

Shipped steers were randomly selected from pasture- and feedlot-finishing groups. Pasture cattle were loaded at approximately 0900 on 2 gooseneck trailers and transported approximately 2 h to Steeles Tavern, VA. Feedlot and pasture cattle were then loaded onto a commercial cattle trailer and transported approximately 6.5 h to Taylor Packing Co., Wyalusing, PA. Cattle were then unloaded and killed the following morning, at which time HCW was recorded for each animal. Carcass characteristics including maturity, fat thickness at the 12th rib, 12th-rib LM area, KPH, marbling score, and USDA quality grade were evaluated by a trained professional 24-h postmortem. The left NAMP 107 ribs (NAMP, 1997) from each carcass were identified, removed, vacuum-packed, purchased, and shipped to a university meat laboratory for later chemical and sensory evaluation. Individual marbling scores were converted to individual USDA quality grades for statistical analysis and presentation. Visual fat color scores were also assigned during data collection. Fat color scores were based on a scale from 1 to 10, with 1 being white and 10 being dark orange.

Statistical Analyses

Winter Period. Stocker performance data were analyzed as a completely randomized design with the GLM procedure (SAS Inst. Inc., Cary, NC). Treatment least squares means were calculated, and means were compared using LSD when protected by a significant ($P < 0.05$) F-value. Pen was used as the experimental unit, with 3 pens per treatment used for replication. The model included winter treatment, pen replicate, year, and winter treatment × year.

Finish Period. Finishing data were analyzed as a completely randomized design with the GLM procedure of SAS. Treatment least squares means were calculated, and means were compared using LSD when protected by a significant ($P < 0.05$) F-value. Finishing performance and carcass data were analyzed as a split-plot, with finishing system as the whole plot, and winter growth rate and the winter × finish interaction in the split-plot. Year was considered a random effect, and winter treatment mean within finishing replication was the experimental unit. For finishing system tests, finish treatment × finish rep was used as the error term. For winter treatment and winter × finish tests, winter treatment × finishing treatment × year was used as the error term.

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RESULTS AND DISCUSSION

Stocker performance on forages can vary greatly, from loss of BW to exceptional gains, and this could be a source of variability in beef quality (Drouillard and Kuhl, 1999). The influence of stocker performance on carcass quality has been well documented within the feedlot sector with findings varying greatly. Impact of stocker performance on meat quality and composition in the feedlot or grass-fed sectors has not been studied. Phillips et al. (1991) compared performance of feeder cattle after being wintered on dormant tall-grass native range or winter wheat (*Triticum aestivum* L.) pasture. Those wintered on dormant grass weighed less before the feedlot period, gained more, and were more efficient during feedlot finishing vs. those wintered on wheat pasture, with no differences in carcass characteristics. Winter period forage diet has been shown to influence ADG, marbling, and quality grade in heifers finished on pasture with supplemental grain (Allen et al., 1996). Heifers wintered on N-fertilized tall fescue (*Festuca arundinacea* Schreb.) hay or silage, had lower ADG, less marbling, and were of lower quality grade than those wintered on orchardgrass (*Dactylis glomerata* L.)/alfalfa (*Medicago sativa* L.) hay. The mean ADG during winter of steers and heifers for N-fertilized tall fescue hay or silage was 0.18 and 0.07 kg, respectively, vs. 0.50 kg for those wintered on orchardgrass-alfalfa hay (Allen et al., 1992). It is unclear if the negative impact on carcass characteristics was due to forage type, nutrient amendment, or rate of gain during winter. Hersom et al. (2004) wintered stocker cattle on wheat pasture at high or low rate of gain, or native range. Cattle were then finished on a concentrate diet. Mean winter ADG for 2 experiments were 1.21, 0.61, and 0.16 for wheat pasture and native range, respectively. They found no differences in feedlot performance, LM area, or marbling score between winter treatments after finishing. However cattle were finished to a like endpoint of 1.27 average back fat, resulting in days on feed being greater for cattle having lower winter period rate of gain. A multi-year, multi-location experiment was conducted with the objective to evaluate the effect of winter feeding regimes on subsequent pasture or feedlot finishing performance, and carcass and meat quality characteristics. We propose that winter rate of gain would impact finishing performance, carcass quality, and meat quality and composition when cattle are finished to an equal-time endpoint.

Winter Period Performance

Final winter BW differed ($P < 0.001$) across all treatments (Table 2). Average daily gains were also different ($P < 0.001$) across treatments and were related to plane of nutrition. Winter end ULMA differed ($P < 0.001$) across winter rate of gain treatments and increased with greater plane of nutrition. The goal was to have 3 separate populations regarding winter ADG and size by the end of the winter stocker period, and this was clearly accomplished.

Finishing Period Performance and Carcass Characteristics

There were no winter × finishing treatment interactions ($P > 0.6$), and thus only the main effects are presented. Lack of interactions indicates winter stocker treatments influenced finishing performance and carcass characteristics similarly in both finishing treatments, and to our knowledge, this has not been demonstrated before. Hersom et al. (2004) showed when cattle were finished on concentrate to a common backfat endpoint, those with low winter rate of gain required greater days on feed and did not express compensatory gain, with ADG being calculated over the entire feeding period. If we had finished feedlot cattle to a common ribfat endpoint, and pasture-finished cattle were slaughtered at the same equal-time endpoint, it is possible that interactions might have occurred. In this case, it is most likely concentrate cattle would not have expressed compensatory gain whereas pasture-finished cattle would have. Regarding carcass characteristics, feedlot cattle would have reached common physiological maturity whereas pasture-finished cattle would not have, and again interactions may have occurred. No differences were detected in fat color via visual scoring between the pasture- and feedlot-finished carcasses, therefore data are not presented (all carcasses were scored as having white fat). Carcass maturity data are not presented as all carcasses received a USDA maturity grade of A.

Finishing Treatment. Feedlot-finished cattle had a greater ($P < 0.001$) mean final BW than pasture-finished (Table 3). Feedlot cattle gained at a faster rate ($P < 0.001$) due undoubtedly to differences in energy density of the diets. Finishing treatment influenced ($P < 0.001$) all carcass traits. Feedlot-finished cattle had heavier HCW, greater LM area, fat thickness, and KPH. Pasture-finished cattle had lower dressing percent, USDA yield grade, and USDA quality grade. Mandell et al. (1998) found similar differences regarding ADG, HCW, LM area, fat thickness, and QG with Limousin-cross steers fed diets of 95.0% (DMB) alfalfa silage or 15.0% alfalfa silage and 76.5% high moisture corn (DMB) when cattle were fed to an equal time endpoint. We did not see any visual difference in carcass fat color (data not shown), which is also in agreement with their work. Realini et al. (2004) found similar differences between HCW, fat thickness, and LM area in pasture- vs. concentrate-finished cattle. With heifers finished on grass or grain the last 83 and 76 d, respectively, Crouse et al. (1984) had similar results regarding quality grade, LM area, KPH, HCW, and BW. Berthiaume et al. (2006) showed that increasing the amount of barley in the diets of steers finished with grass silage resulted in greater rate of gain, heavier HCW, and improved quality grade. Agreement of results with those cited is ex-

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Table 2. Winter stocker phase performance and ultrasound LM area (ULMA) measurements

	Winter gain treatment				
Item	Low	Medium	High	SEM	*P*-value
No. of observations	9	9	9		
BW initial, kg	271	271	267	8.8	0.449
BW final, kg	310[c]	340[b]	370[a]	11.5	>0.001
ADG, kg/d	0.29[c]	0.52[b]	0.79[a]	0.04	>0.001
Beginning ULMA,[1] cm^2	47.1	46.8	45.1	2.7	0.297
Ending ULMA,[1] cm^2	48.1[c]	54.4[b]	59.3[a]	2.5	>0.001

[a–c]Means within a row with different superscripts differ, $P < 0.001$.
[1]Ultrasound measure of LM area.

pected. Steers fed ad libitum intake, greater energy density diets, in restricted confines, would be expected to perform at a greater rate of gain, weigh more at slaughter, and reach a greater state of physiological maturity when finished to an equal-time endpoint. However, the purpose of this study was not to confirm this fact, but determine the influence of winter plane of nutrition on finishing performance, carcass characteristics, and meat quality and composition, and to test if interactions existed between winter rate of gain and finishing system.

Winter Period ADG on Finishing Performance and Carcass Traits. Final BW was influenced ($P < 0.05$) by winter treatment with low and medium being less than high (Table 4). Steers on the low treatment had a greater ($P < 0.05$) ADG than medium and high. However, even with expression of compensatory gain, low cattle had lighter final BW than high. Phillips et al. (2004) and Choat et al. (2003) reported lower beginning BW before finishing, compensatory gain during feedlot finishing, and lighter final BW in cattle grazing native range vs. wheat pasture during winter. Phillips et al. (1991), with similar winter treatments as above, showed similar results in beginning BW and compensatory gain during finishing, with no difference in final BW. In contrast, Hersom et al. (2004) reported that in feedlot finished cattle, those gaining the least during winter did not exhibit compensatory gain during the finishing period when cattle grazed winter wheat or native range during the winter period. However, they fed cattle to a specific endpoint of 1.27-cm back fat resulting in average days on feed for 2 experiments of 87, 114, and 161 d for their high, median, and low winter ADG grazing treatments, respectively. In the case of Phillips et al. (2004) and Choat et al. (2003), cattle were not finished to a specific back fat endpoint; however, low rate of gain cattle were finished for a longer period of time than high rate. Owens et al. (1995) indicated that restriction of energy intake before finishing can increase mature size. It appears that cattle in our study, as well as Phillips et al. (2004) and Choat et al. (2003), had not reached their mature BW and were still expressing compensatory gain, whereas those studied by Hersom et al. (2004) may have been closer to mature BW. Our results show cattle with lower BW before finishing were not able to make up lost gain during stocking with compensatory gain during finishing. This agrees with Phillips et al. (2004) and Choat et al. (2003), in which cattle with low rate of gain during stocking were unable to catch up, even with extended finishing time.

Table 3. Finishing system (pasture vs. feedlot) on steer performance and carcass characteristics

	Finishing Treatment			
Item	Pasture	Feedlot	SEM	*P*-value
No. of observations	27	24		
BW initial, kg	343	350	18.9	0.353
BW final, kg	475	541	19.4	<0.001
ADG, kg/d	0.85	1.23	0.08	<0.001
HCW, kg	247	325	11.2	<0.001
LM area, cm^2	66.2	79.4	3.7	<0.001
Fat thickness, cm	0.47	1.15	0.13	<0.001
KPH, %	1.6	2.4	0.26	<0.001
Dressing percentage[1]	54.0	61.8	0.8	<0.001
USDA yield grade	1.6	2.4	0.29	<0.001
USDA quality grade[2]	2.1	4.1	0.47	<0.001

[1]Computed using 4% shrink on final BW and HCW.
[2]2 = Low Select; 3 = High Select; and 4 = Low Choice.

Hot carcass weight followed the same trend as final BW with steers on low and medium treatments producing lighter ($P < 0.05$) carcasses than high. This is in agreement with results of Phillips et al. (2004) and Choat et al. (2003). Dressing percent for high was greater ($P < 0.001$) than low with medium being intermediate and not differing from low or high. Phillips et al. (2004) and Choat et al. (2003) reported similar results as expected, given greater carcass weights. Carcasses from the high winter treatment had a greater ($P < 0.05$) USDA quality grade than medium and low with all treatments grading low to high Select. In their first experiment, Phillips et al. (2004) reported no difference in quality grade between winter treatments, whereas in the second experiment, wheat pasture showed a slight improvement in quality grade over native pasture. In both experiments cattle were implanted before the winter and finishing phases with carcasses

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Table 4. Performance and carcass characteristics of steers finished on pasture and in feedlot as influenced by winter rate of gain

	Winter rate of gain				
Item	Low	Medium	High	SEM	*P*-value
No. of observations	17	17	17		
BW initial, kg	315[c]	347[b]	378[a]	18.8	<0.001
BW final, kg	495[e]	504[e]	523[d]	19.4	0.020
ADG, kg/d	1.16[d]	1.02[e]	0.94[e]	0.08	0.003
HCW, kg	275[e]	284[e]	299[d]	11.2	0.005
LM area, cm^2	71.6	72.4	74.4	3.7	0.268
Fat thickness, cm	0.77	0.82	0.85	0.13	0.321
KPH, %	1.8	1.9	2.1	0.26	0.071
Dressing percentage[1]	57.1[b]	57.8[ab]	58.8[a]	0.8	0.027
USDA yield grade	1.9	2.1	2.1	0.29	0.140
USDA quality grade[2]	2.8[e]	3.1[e]	3.5[d]	0.47	0.003

[a–c]Means within row with different superscripts differ, $P < 0.01$.
[d,e]Means within row with different superscripts differ, $P < 0.05$.
[1]Computed using 4% shrink on final BW and HCW.
[2]2 = Low Select, 3 = High Select, and 4 = Low Choice.

grading high Standard. Choat et al. (2003) reported no difference in quality grade (Select +) for cattle grazing wheat verses native pasture before finishing. However, cattle were also implanted in their experiment and were fed to similar body composition based on subjective evaluation. This resulted in native pasture cattle being finished for a greater number of days vs. wheat pasture. Quality grade can also indicate extent of physiological maturity (Owens et al., 1995). Administration of implants can influence physiological maturity at a given BW or age (Owens et al., 1995) and thus influence quality grade. Because cattle in our study were not implanted, influence of winter gain and use of implant were not confounded, and thus differences in USDA quality grade between winter treatments are likely due to physiological maturity.

In the current study, carcass characteristics LM area, fat thickness, KPH, and USDA yield grade were not influenced ($P > 0.05$) by winter treatment. However, there was a trend for cattle gaining more in winter to have greater KPH ($P < 0.1$). Phillips et al. (2004) showed similar results for fat thickness and greater LM area for wheat pasture vs. native range cattle in experiment 1, but in experiment 2, native range cattle had greater fat thickness and similar LM area and USDA yield grade vs. wheat. Choat et al. (2003) reported similar results to ours regarding fat thickness and USDA yield grade, but greater winter rate of gain resulted in larger LM area and greater KPH. Interpretation between experiments is difficult due to lack of growth implant use in our study. Use of implants impacts lean and fat tissue accretion (Owens et al., 1995) and thus confounds the results of the cited studies. It appears cattle on low and medium winter treatments had caught up to high in terms of lean tissue accretion but not with regard to fat tissue as indicated by lower USDA quality grade, the trend for lower KPH, and similarity between treatments in LM area. This is in agreement with Owens et al. (1995) in terms of lean and fat tissue accretion in relation to BW.

In summary, small-scale pasture- and concentrate-fed operations are often unable to finish steers to a specific physiological endpoint. Animal performance during stocking clearly impacts finishing performance, carcass quality, and beef production when cattle are finished to an equal-time endpoint. Although compensatory gain was expressed during finishing, it did not make up for lost winter gain. The USDA quality grade was sacrificed in low and medium rate of gain treatments. Because most pasture-fed beef is not sold as a commodity product, this may not be detrimental unless it compromises consumer acceptance. Cattle that perform at lower rates during winter may be able to improve carcass quantity and quality if finished for a longer period of time, and that strategy could be useful to expand the slaughter window and improve the distribution of product in time. Our recommendation is for a minimum ADG of 0.45 kg during the winter stocker period to maximize beef production and carcass quality during finishing.

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