Effects of low-stress weaning on calf growth performance and carcass characteristics

E.R. Gubbels, R.R. Salverson, K.M. Cammack, J.K. Grubbs, K.R. Underwood, K.C. Olson, A.D. Blair

Objective

The objective of this study was to compare the influence of two low-stress weaning methods with conventional weaning on post-weaning performance and carcass characteristics of beef steers.

Study Description

Steer calves (n=90) were stratified by body weight and dam age into three groups; one treatment was randomly assigned to each group: ABRUPT (calves isolated from dams on the day of weaning), FENCE (calves separated from dams via a barbed wire fence for 7 days prior to completely weaning), and NOSE (nose-flap inserted and calves remained with dams for 7 days prior to completely weaning). To understand the influence of each weaning method on haptoglobin (an acute-phase stress protein), blood samples were collected via coccygeal venipuncture. Body weights (BW) were recorded on study day -34 (PreWean), -7 (PreTreat), 0 (Weaning), 7 (PostWean), 32 (Receiving), 175 (Ultrasound), and 253 (Final) and average daily gains (ADG) were calculated between each time period. On day 175 post-weaning BW were recorded, and ultrasound fat thickness and intramuscular fat were determined and utilized to project marketing dates. Carcass measurements were recorded at the time of harvest and included hot carcass weight, 12th rib backfat, ribeye area, USDA Yield Grade and Quality Grade, and marbling score.

Take home points

Weaning method interacted ($P < 0.0001$) with time period for ADG and BW. Calf BW increased in all treatments until the PostWean period, wherein BW decreased ($P < 0.0001$) in ABRUPT and NOSE, and was maintained ($P > 0.05$) in FENCE. From the Receiving to Final time periods BW increased similarly ($P > 0.05$) for all treatments. Calf ADG was greater ($P < 0.01$) in calves in the NOSE treatment at Weaning than ABRUPT or FENCE. In the PostWean period, the FENCE calves had ADG that was not different ($P > 0.05$) than zero but was greater ($P < 0.0001$) than the negative ADG of ABRUPT and NOSE calves. During the Receiving period ADG was greater ($P < 0.05$) for ABRUPT compared to NOSE and FENCE. Time influenced ($P < 0.001$) haptoglobin concentration. No difference in haptoglobin was observed between the PreTreat and Weaning or PostWean periods; however, haptoglobin concentration was greater ($P < 0.001$) at PostWean compared to Weaning. Weaning method did not influence ($P > 0.05$) carcass measurements. Collectively these data suggest low-stress weaning methods do not significantly improve post-

weaning growth performance or carcass merit compared to calves weaned using conventional methods.

Keywords: beef, carcass, growth performance, haptoglobin, low-stress weaning

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Abstract

The objective of this study was to compare the influence of two low-stress weaning methods with conventional weaning on post-weaning performance and carcass characteristics of beef steers. Steer calves (n = 90) from a single source were stratified by body weight and dam age into three groups; one treatment was randomly assigned to each group: ABRUPT (calves isolated from dams on the day of weaning), FENCE (calves separated from dams via a barbed wire fence for 7 days prior to completely weaning), and NOSE (nose-flap inserted and calves remained with dams for 7 days prior to completely weaning). At day +7 post-weaning calves were transported to a commercial feedlot where they received standard step-up and finishing rations typical for a Northern Plains feedlot. To understand the influence of each weaning method on haptoglobin (an acute-phase stress protein), blood samples were collected via coccygeal venipuncture at day -7 (PreTreat), 0 (Weaning), and +7 (PostWean) from a subsample of calves (n = 10 per treatment) and analyzed using a bovine haptoglobin ELISA kit. Body weights (BW) were recorded on study day -34 (PreWean), -7 (PreTreat), 0 (Weaning), 7 (PostWean), 32 (Receiving), 175 (Ultrasound), and 253 (Final) and average daily gains (ADG) were calculated between each time period. On day 175 post-weaning BW were recorded, and ultrasound fat thickness and intramuscular fat were determined and utilized to project marketing dates. Carcass measurements were recorded at the time of harvest and included hot carcass weight, 12th rib backfat, ribeye area, USDA Yield Grade and Quality Grade, and marbling score. Weaning method interacted ($P < 0.0001$) with time period for ADG and BW. Calf BW increased in all treatments until the PostWean period, wherein BW decreased ($P < 0.0001$) in ABRUPT and NOSE, and was maintained ($P > 0.05$) in FENCE. From the Receiving to Final time periods BW increased similarly ($P > 0.05$) for all treatments. Calf ADG was greater ($P < 0.01$) in calves in the NOSE treatment at Weaning than ABRUPT or FENCE. In the PostWean period, the FENCE calves had ADG that was not different ($P > 0.05$) than zero but was greater ($P < 0.0001$) than the negative ADG of ABRUPT and NOSE calves. During the Receiving period ADG was greater ($P < 0.05$) for ABRUPT compared to NOSE and FENCE. Time influenced ($P < 0.001$) haptoglobin concentration. No difference in haptoglobin was observed between the PreTreat and Weaning or PostWean periods; however, haptoglobin concentration was greater ($P < 0.001$) at PostWean compared to Weaning. Weaning method did not influence ($P > 0.05$) carcass measurements. Collectively these data suggest low-stress weaning methods do not significantly improve post-weaning growth performance or carcass merit compared to calves weaned using conventional methods.

Introduction

Weaning is known to be a stressful event in a calf’s life. Weaning stress can result in behavioral, hormone and immune function alterations (Lynch et al. 2012). Stress during this time has also been shown to negatively impact calf health and performance (Boland et al. 2008). Therefore, alternative weaning strategies have been implemented if efforts to reduce stress at weaning. Acute phase proteins (such as haptoglobin), are stimulated as a defense mechanism in response to trauma, inflammation, or infection (Hughes et al. 2014). Concentrations of acute phase proteins have shown to be indicators of stress in weaned calves (Arthington et al. 2003). In later works by Arthington et al. (2008), they reported preweaned calves tended to have reduced haptoglobin concentrations.

Low-stress weaning strategies aim to divide the weaning process into two stages: 1) physical separation and 2) separation from milk as a nutritional source. It is suggested that two-stage methods decrease the degree of changes in behavior as opposed to simultaneous social and nutritional separation (Haley et al. 2005). Two low-stress strategies that have been utilized in the beef industry include fence-line weaning and using anti-suckling devices. Fence-line weaning involves separation of calves from their dams via a fence such that they still remain in adjacent pens or pastures. Anti-suckling devices are inserted into a calf's nose to prevent nursing but allow contact between the calf and dams. Research has evaluated the influence of low-stress methods on calf physiology, performance, and health for a short period after the weaning process (Boyles et al. 2007; Boland et al. 2008; Campistol et al. 2013). In general calves weaned using low-stress methods are heavier one-week post-weaning when compared to calves weaned using conventional methods (Campistol et al. 2013). Haley et al. (2005) also reported greater average daily gains in calves weaned using a two-stage method the week following weaning. However, the additional performance of the calves in the study conducted by Campistol et al. 2013 as well as the calves in the study by Haley et al. (2005) after weeks 5 and 6 respectively, was not recorded.

Knowledge of the impact of low-stress weaning methods on long-term feedlot performance and carcass characteristics of beef cattle is limited. At approximately 4 to 8 months of age, new fat cells are forming and existing cell growth is occurring. This is referred to as the marbling "window" as suggested by Du et al. (2013). It is also during this time when calves are typically weaned. Stress at this stage could potentially discourage fat cell growth and ultimately reduce the amount of intramuscular fat (marbling) present. Reduced marbling scores correspond to lower USDA Quality Grades. Therefore it is plausible that stress incurred during weaning could compromise overall intramuscular fat deposition. We hypothesized low-stress weaning methods would alter growth performance and carcass characteristics in steers. To test this, we compared the influence of two low-stress weaning methods with conventional weaning on post-weaning performance and carcass characteristics of steers.

Experimental Procedures

Steer calves (n = 90) from a single source were stratified by body weight and dam age into three groups; one treatment was randomly assigned to each group: ABRUPT (calves isolated from dams on the day of weaning), FENCE (calves separated from dams via a barbed wire fence for 7 days prior to completely weaning), and NOSE (nose-flap inserted and calves remained with dams for 7 days prior to completely weaning). At day +7 post-weaning calves were transported to a commercial feedlot where they received standard step-up and finishing rations typical for a Northern Plains feedlot. To understand the influence of each weaning method on haptoglobin (an acute-phase protein), blood samples were collected via coccygeal venipuncture at day -7 (PreTreat), 0 (Weaning), and +7 (PostWean) from a subsample of calves (n = 10 per treatment) and analyzed using a bovine haptoglobin ELISA kit. Body weights (BW) were recorded on study day -34 (PreWean), -7 (PreTreat), 0 (Weaning), 7 (PostWean), 32 (Receiving), 175 (Ultrasound), and 253 (Final) and average daily gains (ADG) were calculated between each time period. On day 175 post-weaning BW were recorded, and ultrasound fat thickness and intramuscular fat were determined and utilized to project marketing dates. Carcass measurements were recorded at the time of harvest and included hot carcass weight, 12th rib backfat, ribeye area, USDA Yield Grade and Quality Grade, and marbling score. Haptoglobin, BW, and ADG data were analyzed as repeated measures using the ante-dependence covariance structure in the MIXED procedure of SAS (SAS Inst. Inc., Cary, NC) for effects of weaning treatment, day, and their interaction; birth weight was included as a covariate for ADG and BW. Carcass traits were analyzed for the effect of weaning treatment using the MIXED procedure. Separation of least-squares means was performed using LSD with a Tukey's adjustment and assuming an alpha level of 0.05.

Results and Discussion

Time influenced ($P < 0.001$) haptoglobin concentration (Figure 1). No difference in haptoglobin was observed between the PreTreat and Weaning or PostWean periods; however, haptoglobin concentration was greater ($P < 0.001$) at PostWean compared to Weaning. Weaning method interacted ($P < 0.0001$) with time period for ADG and BW. Calf BW increased in all treatments until the PostWean period, wherein BW decreased ($P < 0.0001$) in ABRUPT and NOSE, and was maintained ($P > 0.05$) in FENCE (Figure 2). This is similar to findings by Campistol et al. (2013) wherein calves weaned using low-stress methods were shown to have increased ($P < 0.01$) total body weight one-week post-weaning when compared to calves weaned using conventional methods. From the Receiving to Final time periods BW increased similarly ($P > 0.05$) for all treatments. Calf ADG was greater ($P < 0.01$) in calves in the NOSE treatment at Weaning than ABRUPT or FENCE (Figure 3). In the PostWean period, the FENCE calves had ADG that was not different ($P > 0.05$) than zero but was greater ($P < 0.0001$) than the negative ADG of ABRUPT and NOSE calves. This corresponds with Haley et al. (2005) where greater average daily gains were observed one week post-weaning in calves weaned using a two-stage method. In addition, calves weaned in two-stages spent less ($P < 0.0001$) time walking and a greater ($P < 0.0001$) amount of time eating than calves weaned using conventional methods. However, this contradicts Campistol et al. (2013) who reported weight gains during this time were greater ($P < 0.05$) in calves that did not have a low-stress method applied compared to calves weaned conventionally. During the Receiving period in the current study, ADG was greater ($P < 0.05$) for ABRUPT compared to NOSE and FENCE. Weaning method did not influence ($P > 0.05$) carcass measurements (Table 1).

Implications

Collectively these data suggest low-stress weaning methods do not significantly improve post-weaning growth performance or carcass merit compared to calves weaning using conventional methods. However, the weaning method a producer chooses will not negatively impact carcass traits. Moreover, it may be efficacious for producers to take into consideration and implement low-stress weaning methods for improved performance at weaning in early backgrounding phases.

Acknowledgements
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References
Arthington, J. D., S. D. Eicher, W. E. Kunkle, and F. G. Martin. 2003. J. Anim. Sci. 81:1120–1125

Arthington J. D., Qiu X, Cooke R. F., Vendramini J. M., Araujo D. B., Chase C. C. Jr., Coleman S. W. 2008. J. Anim Sci. 86(8):2016-23

Boland, H.T., G. Scaglia, W.S. Swecker Jr., and N.C. Burke. 2008. Prof. Anim. Sci. 24: 539-551

Boyles, S.L., S.C. Loerch, and G.D. Lowe. 2007. Prof. Anim. Sci. 23: 637-641

Campistol, C., Kattesh, H. G., J. C. Waller, E. L. Rawls, J. D. Arthington, T. E. Engle, J. A. Carroll, G. M. Pighetti, and A. M. Saxton. 2013. Prof. Anim. Sci. 29:501-507

Du, M., Y. Huang, A.K. Das, Q. Yang, M.S. Duarte, M.V. Dodson, and M.J. Zhu. 2013. J. Anim. Sci. 91:1419-1427

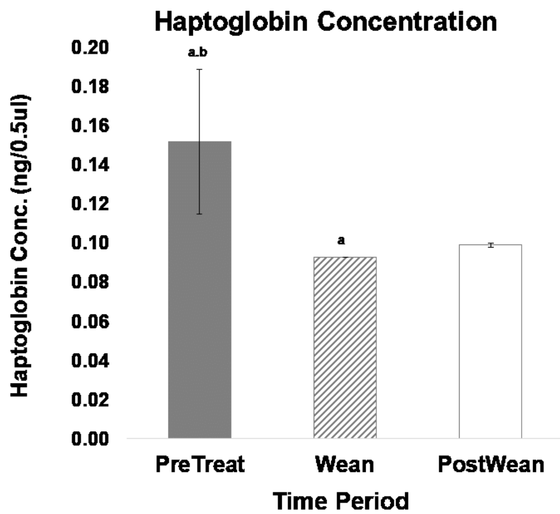
Haley, D. B., D. W. Bailey, and J. M. Stookey. 2005. J. Anim. Sci. 83:2205-2214

Lynch, E. M., McGee, M., Doyle, S., and Earley, B. 2012. BMC Vet. Research 8:1. doi:10.1186/1746-6148-8-1

Table 1. Least squares means for effect of weaning treatments on carcass characteristics and meat quality.

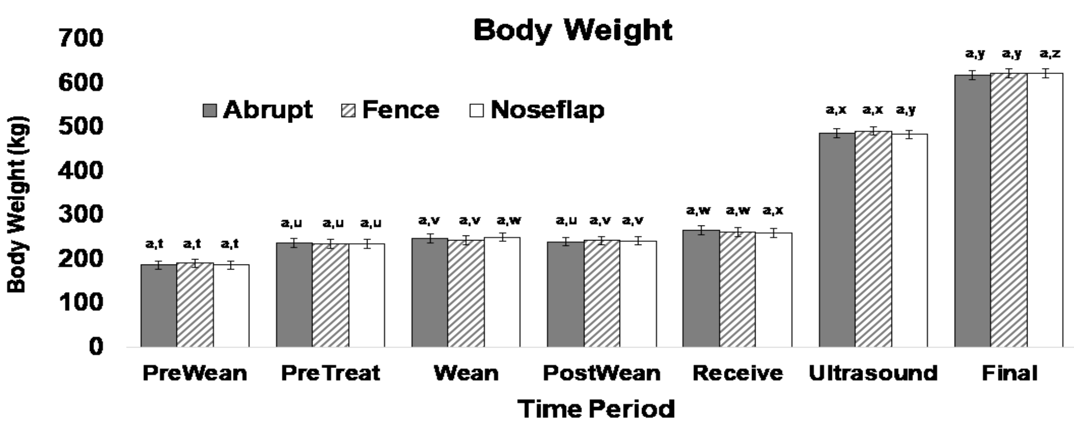
Variable	ABRUPT[1]	FENCE[1]	NOSE[1]	SEM[2]	P-value[3]
Hot carcass weight, kg	387	390	389	6.5	0.941
Ribeye area, cm^2	87.42	87.61	89.42	1.884	0.697
12^{th} rib fat thickness, cm	1.37	1.40	1.55	0.071	0.121
USDA Yield Grade	3.13	3.20	3.27	0.114	0.712
Marbling score[4]	504	541	512	18.5	0.333

[1]Treatments; ABRUPT = n=29 steers, FENCE = n=30 steers, and NOSE = n=30 steers
[2]Standard error of the mean
[3]Probability of difference among least square means
[4]Marbling score: 400 = Small^0, 500 = Modest^0, 600 = Moderate^0



[a.b] Means lacking a common superscript differ P < 0.001

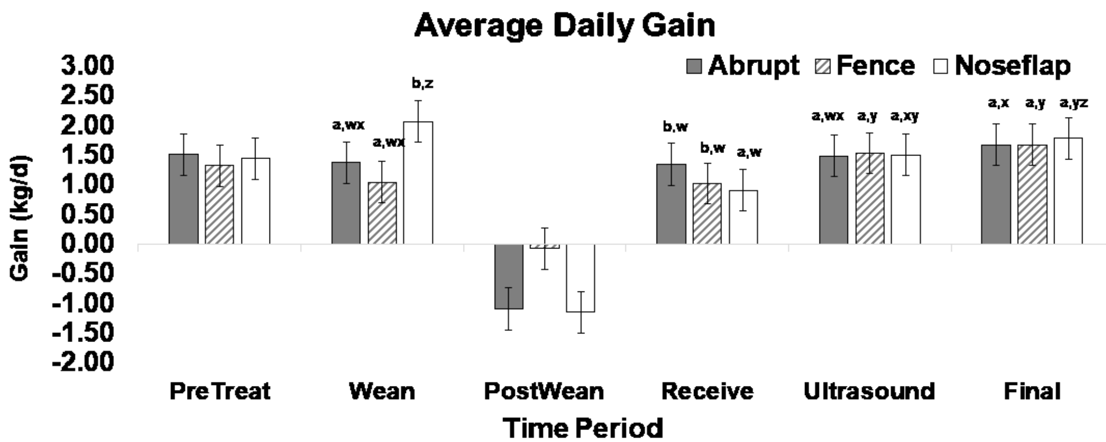
Figure 1. Haptoglobin concentration means by time period.



[a] LSmeans comparing treatments within each time period lacking a common superscript differ ($P \leq 0.05$).

[t,u,v,w,x,y,z] LSmeans comparing time period within each treatment lacking a common superscript differ ($P \leq 0.05$).

Figure 2. Body weight treatment means by time period.



[a.b] LSmeans comparing treatments within each time period lacking a common superscript differ ($P \leq 0.05$).

[v,w,x,y,z] LSmeans comparing time period within each treatment lacking a common superscript differ ($P \leq 0.05$).

Figure 3. Average daily gain treatment means by time period