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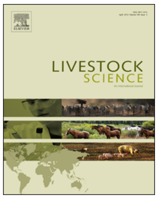

Impacts of cow body condition score during gestation on weaning performance of the offspring

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ABSTRACT

This experiment evaluated the impacts of cow body condition score (**BCS**) during gestation on productive parameters of the offspring. Three hundred multiparous, lactating, non-pregnant Angus × Hereford cows were assigned to a fixed-time artificial insemination (**AI**) protocol using semen from a single sire (d 0). Forty days after AI, cows were evaluated for pregnancy status via transrectal ultrasonography and BCS, and 100 pregnant cows (543 ± 6 kg of BW, 6.6 ± 0.3 yr of age, 4.83 ± 0.06 of BCS, and 115 ± 2 d postpartum) were selected for the experiment. Within these 100 cows, 20 cows had BCS ≥ 5.50 but ≤ 6.50 and were classified as adequate BCS (5.85 ± 0.06; **HBCS**). The remaining cows had BCS ≤ 4.75 (4.52 ± 0.03), and were divided into 4 groups (20 cows/group): **LBCS** (4.60 ± 0.07), **BCSG1** (4.43 ± 0.07), **BCSG2** (4.63 ± 0.07), and **BCSG3** (4.63 ± 0.07). The HBCS and LBCS cows were managed to maintain their initial BCS throughout gestation. The BCSG1, BCSG2, and BCSG3 cows were managed to gain 1.50 BCS during the first, second, and third trimester of gestation, respectively, and maintain the resultant BCS until calving. Cow BCS was assessed again on d 102, 182, and 265. During the calving season (d 272-291), calf body weight (**BW**) was recorded within 3 h after birth. Only cows that met the BCS maintenance (within 0.50 of BCS change) and change (≥ 1.25 and ≤ 1.75 of BCS increase within the trimester) criteria were maintained in the experiment (HBCS, $n = 14$; LBCS, $n = 14$; BCSG1, $n = 14$; BCSG2, $n = 15$, BCSG3, $n = 15$). On d 344, cow milk production was estimated by the weigh-suckle-weigh method, and calves were weaned on d 475. No differences were detected ($P \geq 0.42$) for calving rate, calf birth BW, and cow milk production. Weaning rate and calf age at weaning were also similar among BCS groups ($P \geq 0.15$). However, calf weaning BW was greater ($P \leq 0.05$) for BCSG2 and BCSG3 cows (265 and 262 kg, respectively; SEM $= 4$) compared with HBCS and LBCS cows (248 and 249 kg, respectively; SEM $= 4$), and similar ($P \geq 0.20$) among all other comparisons. These results suggest that offspring weaning BW is directly influenced by BCS gain of beef cows during the second and third trimesters of gestation.

1. Introduction

Research has established that cow nutritional status during gestation directly impacts long-term offspring productivity via fetal programming effects (Funston et al., 2010; Reynolds et al., 2010). Body condition score (**BCS**) is widely used to assess cattle nutritional status (Wagner et al., 1988), whereas BCS during gestation is known to influence productive responses of beef cows such as reproductive performance (Richards et al., 1986; Cooke et al., 2009). Recent research from our group also demonstrated that cow BCS during late gestation has fetal programming implications (Bohnert et al., 2013). In that study, cows managed to sustain BCS ≈ 5.5 during the last trimester of gestation had greater calving rate, weaning rate, and tended to wean heavier calves compared with cohorts managed to sustain a BCS ≈ 4.5.

Dietary supplementation and subsequent increase in BCS has been widely used to stimulate and investigate fetal programing effects in beef cattle (Funston et al., 2012). In fact, cows with BCS ≈ 5.5 evaluated by Bohnert et al. (2013) were supplemented during mid-gestation to achieve the desired BCS during the last trimester of gestation. Re-alimentation and consequent BCS gain during late gestation can offset the negative consequences of inadequate nutrition during early and mid-gestation on fetal development and offspring productivity (Long et al., 2009, 2010). More importantly, BCS gain reflects a positive nutritional balance due to nutrient flushing, which is known to enhance reproductive function in livestock (Dunn and Moss, 1992) and likely has fetal programming effects by increasing nutrient delivery to the

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developing fetus (Wu et al., 2006). Therefore, it is unknown if the outcomes reported by Bohnert et al. (2013) were due to cow BCS sustained during late gestation, BCS gain during mid-gestation, or a combination of both. Based on this information, we hypothesized that cow BCS gain during gestation has a greater impact on offspring productivity compared with sustained BCS. Hence, this experiment compared cow-calf productivity parameters from beef cows that sustained BCS during gestation, or that gained BCS within each trimester of gestation.

2. Materials and methods

This experiment was conducted at the Oregon State University – Eastern Oregon Agricultural Research Center (Burns station). The animals utilized were cared for in accordance with acceptable practices and experimental protocols reviewed and approved by the Oregon State University, Institutional Animal Care and Use Committee (#4521).

2.1. Animals and treatments

Three hundred multiparous, non-lactating, pregnant Angus × Hereford cows were assigned to a fixed-time artificial insemination (**AI**) protocol (Cooke et al., 2014) using semen from a single sire (d 0 of the experiment), and exposed to mature Angus bulls for 50 d beginning on d 18. On d 40, cows were evaluated for pregnancy status via transrectal ultrasonography, BW, and BCS, and 100 cows pregnant to AI (mean ± SE here and throughout; 543 ± 6 kg of BW, 6.6 ± 0.27 yr of age, 4.83 ± 0.06 of BCS, and 115 ± 2 d postpartum) were selected for the experiment. Within these 100 cows, 20 cows had BCS ≥ 5.50 but ≤ 6.50 and were classified as adequate BCS (5.85 ± 0.06; **HBCS**). The remaining cows had BCS ≤ 4.75 (4.52 ± 0.03), and were divided into 4 groups of 20 cows each: **LBCS** (4.60 ± 0.07), **BCSG1** (4.43 ± 0.07), **BCSG2** (4.63 ± 0.07), and **BCSG3** (4.63 ± 0.07).

The LBCS and HBCS cows were managed to maintain their initial BCS throughout gestation at levels classically considered to be, respectively, inadequate or adequate for beef cow performance (Richards et al., 1986; Wagner et al., 1988; Kunkle et al., 1994). The BCSG1, BCSG2, and BCSG3 cows were managed to gain 1.50 BCS during the first, second, and third trimester of gestation, which was the BCS gain during mid-gestation reported by Bohnert et al. (2013), and maintain the resultant BCS until calving. Immediately after calving, all cow-calf pairs were assigned to the general management of the research herd (Cooke et al., 2012, 2014). Cattle management details are reported in Table 1 and are similar to the research approach employed by Bohnert et al. (2013). Calves were administered Clostrishield 7 and Virashield 6+ Somnus (Novartis Animal Health, Bucyrus, KS, USA) on d 320 and were weaned on d 475 of the experiment. Throughout the experiment, cattle had ad libitum access to water and a commercial mineral and vitamin mix (Cattleman's Choice; Performix Nutrition Systems, Nampa, ID) containing 14% Ca, 10% P, 16% NaCl, 1.5% Mg, 6000 ppm Zn, 3200 ppm Cu, 65 ppm I, 900 ppm Mn, 140 ppm Se, 136 IU/g of vitamin A, 13 IU/g of vitamin D_3, and 0.05 IU/g of vitamin E.

2.2. Sampling

Feed and forage samples (Ganskopp and Bohnert, 2009) were collected monthly during the experiment, and analyzed for nutrient content. Each sample was analyzed in triplicate by wet chemistry procedures for concentrations of CP (method 984.13; AOAC, 2006), ADF (method 973.18 modified for use in an Ankom 200 fiber analyzer, Ankom Technology Corp., Fairport, NY; AOAC, 2006), and NDF (Van Soest et al., 1991; modified for Ankom 200 fiber analyzer, Ankom Technology Corp.). Calculations for TDN used the equation proposed by Weiss et al. (1992).

Table 1
Management to cows to maintain inadequate (**LBCS**; n = 14) or adequate (**HBCS**; n = 14) body condition score throughout gestation, or to gain body condition score during the first (**BCSG1**; n = 14), second (**BCSG2**; n = 15), and third (**BCSG3**; n = 15) trimester of gestation and maintain the resultant body condition score until calving.[a,b]

BCS Group	Gestation management			Post-calving management	
	1st trimester (d 40 to 102)	2nd trimester (d 103 to 182)	3rd trimester (d 183 to calving)	Calving until d 344	d 340 until d 475
LBCS	A	A	C + E + F	C + F + H	D
HBCS	B	C + F + G	C + F + H	C + F + H	D
BCSG1	B + F	C + F + G	C + F + H	C + F + H	D
BCSG2	A	C + F + G + I	C + F + H	C + F + H	D
BCSG3	A	A	C + F + H + I	C + F + H	D

[a] A = Range pasture with ad libitum access to forage (49.4% TDN and 4.1% CP; DM basis), B = Meadow foxtail (*Alopecurus pratensis* L.) pasture with ad libitum access to forage (58.7% TDN and 7.5% CP; DM basis), C = Meadow foxtail pasture previously harvested for hay and with negligible forage availability, D = Range pasture with ad libitum access to forage (55.5% TDN and 10.2% CP; DM basis according to Ganskopp and Bohnert, 2009).

[b] E = Grass straw (53% TDN and 4.6% CP; DM basis), F = Alfalfa hay (63.1% TDN and 20.0% CP; DM basis); G = Meadow foxtail hay (56.0% TDN and 8.2% CP; DM basis), H = ground corn (90% TDN and 8.9% CP; DM basis), I = dried distillers grain with solubles (87% TDN and 30.9% CP; DM basis).

Individual cow full body weight (**BW**) and BCS (Wagner et al., 1988) were recorded on d 40, 102, 182, 265, 344 (BCS only), and 475. Further, BCS was evaluated by the same 3 evaluators, which were blinded to which BCS group the assessed cow was assigned to. Only cows that met the BCS maintenance (within 0.50 of BCS change) and change (≥ 1.25 and ≤ 1.75 of BCS increase within the trimester) criteria were used in the experiment (HBCS, n = 14; LBCS, n = 14; BCSG1, n = 14; BCSG2, n = 15, BCSG3, n = 15). The maintenance criterion was based on the expected variation in BCS scoring across evaluators and sampling events, whereas the BCS gain criterion was based on Bohnert et al. (2013). Overall BCS and BCS change during the experiment of cows that met requirements are reported in Table 2.

During the calving season (d 272–291), calf full BW was recorded within 3 h after birth. No incidences of dystocia were observed in the present experiment. On d 344, cow milk production was estimated by the weigh-suckle-weigh method (Aguiar et al., 2015). More specifically, calves were separated from their dams for 8 h and allowed to suckle for 30 min. Milk yield was calculated as the difference between pre- and post-suckling calf BW. Milk yield was adjusted to 24 h by multiplying the observed difference in pre- and post-suckling calf BW by 3. Calf full BW was determined on d 475 (weaning) and 476, and values averaged to represent calf weaning BW and calculate average daily gain (**ADG**) from birth to weaning.

2.3. Statistical analysis

All data were analyzed using cow(BCS group) as random variable, with SAS (SAS Inst. Inc., Cary, NC, USA; version 9.3) and Satterthwaite approximation to determine the denominator df for the tests of fixed effects. Cow BCS was assessed individually and only cows that met the BCS criteria adopted herein were used in the experiment; therefore, cow was considered the experimental

Table 2
Body condition score of cows that maintained inadequate (**LBCS**; n = 14) or adequate (**HBCS**; n = 14) body condition score throughout gestation, or that gained body condition score during the first (**BCSG1**; n = 14), second (**BCSG2**; n = 15), and third (**BCSG3**; n = 15) trimester of gestation and maintained the resultant body condition score until calving.[a,b]

Item	LBCS	BCSG1	BCSG2	BCSG3	HBCS	SEM	P =
d 40 (start of experiment)	4.51^{a}	4.43^{a}	4.46^{a}	4.49^{a}	5.70^{b}	0.07	<0.01
Change from d 40 to 102	0.08^{a}	1.42^{b}	0.06^{a}	0.13^{a}	0.17^{a}	0.09	<0.01
d 102 (start of 2st trimester of gestation)	4.60^{a}	5.86^{b}	4.52^{a}	4.60^{a}	5.87^{b}	0.09	<0.01
Change from d 102 to 182	0.09^{a}	0.17^{a}	1.58^{b}	0.19^{a}	0.27^{a}	0.10	<0.01
d 182 (start of 3rd trimester of gestation)	4.73^{a}	6.00^{b}	6.09^{b}	4.76^{a}	6.14^{b}	0.09	<0.01
Change from d 182 to 265	0.12^{a}	0.07^{a}	0.07^{a}	1.29^{b}	0.12^{a}	0.07	<0.01
d 265 (start of calving season)	4.86^{a}	6.07^{b}	6.16^{b}	6.06^{b}	6.26^{b}	0.10	<0.01
Change from d 265 to 344	0.35^{a}	0.00^{b}	0.03^{b}	-0.33^{c}	0.34^{a}	0.13	<0.01
d 344 (post-calving)	5.21^{a}	6.07^{b,c}	6.20^{b}	5.72^{c}	6.60^{d}	0.16	<0.01
Change from d 344 to 475	-0.56^{a}	-1.00^{b}	-1.18^{b}	$-0.66^{a,b}$	-1.04^{b}	0.15	<0.01
d 475 (calf weaning)	4.64^{a}	5.10^{b}	5.02^{b}	5.06^{b}	5.57^{c}	0.10	<0.01

[a] Body condition score was assessed according to Wagner et al. (1988) by the same 3 evaluators, which were blinded to which BCS group the assessed cow was assigned to. All cows were inseminated on d 0 and became pregnant according to transrectal ultrasonography exam performed on d 40. Cows calves between d 272 to 291, and these calves were weaned on d 475.

[b] Means with different superscripts (a,b,c) differ ($P < 0.05$).

unit. Quantitative data were analyzed with the MIXED procedure, whereas binary data were analyzed with the GLIMMIX procedure. The model statement used for cow performance analysis contained the effect of BCS group, in addition to days postpartum as an independent covariate for milk yield. The model statement used for calf and cow-calf performance analysis contained the effect of BCS group, calf sex, and the resultant interaction. Results are reported as least square means, and separated using Bonferroni-adjusted PDIFF to prevent type I errors. Significance was set at $P \leq 0.05$, and tendencies were determined if $P > 0.05$ and ≤ 0.10. Results are reported according to BCS group effects if no interactions were significant, or according to the highest-order interaction detected containing the BCS group variable.

3. Results and discussion

Table 2 describes BCS parameters in cows that were used in this experiment. Based on our experimental design, cow BCS and BCS change during gestation varied ($P < 0.01$) according to each BCS group. Cow BW yielded comparable results ($P < 0.01$; Table 3) as BCS parameters. The few discrepancies observed among BCS and BW results (Tables 2 and 3) can be associated with the fact that BW change include synthesis of body tissues as well as fluctuations in feed and water consumption, whereas BCS reflects the body tissue status without being influenced by the content of the gastrointestinal tract. Hence, BCS better indicates nutritional status than BW change in cattle (West et al., 1990; Dunn and Moss, 1992), supporting the use of this variable in the present experiment.

Upon calving and until weaning, all cows were managed similarly. Yet, BCS and BW from LBCS cows were still reduced ($P < 0.01$) compared with all other BCS groups on d 344 and 475 (Tables 2 and 3). Adequate BCS during the postpartum period is critical for cow reproductive function and performance (Richards et al., 1986; Kunkle et al., 1994; Cooke and Arthington, 2008), whereas these parameters were not evaluated herein because this experiment was not properly designed to evaluate reproductive variables. Nevertheless, Bohnert et al. (2013) reported that cows managed to sustain BCS ≈ 5.5 during the last trimester of gestation had greater pregnancy rates during the following breeding season, and greater BW and BCS at weaning, compared with cohorts managed to maintain a BCS ≈ 4.5, despite similar nutritional management post-calving. Hence, our results further support the importance of proper gestational nutrition to ensure that, during the subsequent breeding season, cows are in adequate BCS and have optimal reproductive performance.

No BCS group effects were detected ($P \geq 0.49$) for calving rate, calf birth BW, as well as kg of calf born per cow assigned to the experiment (Table 4). The effects of cow BCS during gestation on calving parameters described in the literature have been inconsistent. Bohnert et al. (2013) reported reduced calving rate and calf birth BW in cows managed to sustain a BCS ≈ 4.5 during the last trimester of gestation. Spitzer et al. (1995) and Winterholler et al. (2012) also reported a positive relationship among cow BCS during late gestation and calf birth BW. Conversely, others reported similar calving rate and calf birth BW among cows differing in BCS

Table 3
Body weight (kg) of cows that maintained inadequate (**LBCS**; n = 14) or adequate (**HBCS**; n = 14) body condition score throughout gestation, or that gained body condition score during the first (**BCSG1**; n = 14), second (**BCSG2**; n = 15), and third (**BCSG3**; n = 15) trimester of gestation and maintained the resultant body condition score until calving.[a,b]

Item	LBCS	BCSG1	BCSG2	BCSG3	HBCS	SEM	P =
d 40 (start of experiment)	483^{a}	539^{b}	529^{b}	546^{b}	582^{c}	11	<0.01
Change from d 40 to 102	6^{a,b}	60^{c}	-4^{a}	-20^{a}	22^{b}	11	<0.01
d 102 (start of 2st trimester of gestation)	489^{a}	599^{b}	525^{c}	528^{c}	604^{b}	13	<0.01
Change from d 102 to 182	-4^{a}	11^{a}	76^{b}	9^{a}	15^{a}	13	<0.01
d 182 (start of 3rd trimester of gestation)	486^{a}	609^{b}	601^{b}	533^{c}	620^{b}	11	<0.01
Change from d 182 to 265	142^{a}	83^{b}	96^{b}	151^{a}	96^{b}	7	<0.01
d 265 (start of calving season)	630^{a}	693^{a,b}	696^{a,b}	684^{c}	716^{b}	12	<0.01
Change from d 265 to 475	-84^{a}	$-98^{a,b}$	-106^{b}	$-92^{a,b}$	$-93^{a,b}$	7	<0.01
d 475 (calf weaning)	544^{a}	594^{b}	590^{b}	593^{b}	623^{c}	12	<0.01

[a] All cows were inseminated on d 0 and became pregnant according to transrectal ultrasonography exam performed on d 40. Cows calves between d 272–291, and these calves were weaned on d 475.

[b] Means with different superscripts (a,b,c) differ ($P < 0.05$).

Table 4
Calving, milk production, and weaning outcomes from cows that maintained inadequate (**LBCS**; n = 14) or adequate (**HBCS**; n = 14) body condition score throughout gestation, or cows that gained body condition score during the first (**BCSG1**; n = 14), second (**BCSG2**; n = 15), and third (**BCSG3**; n = 15) trimester of gestation and maintained the resultant body condition score until calving.[a,b]

Item	LBCS	BCSG1	BCSG2	BCSG3	HBCS	SEM	P =
Calving results							
Calving rate, %	92.3	92.3	100	100	100	4.5	0.49
Calf birth BW, kg	43.9	42.8	43.8	41.9	42.4	1.4	0.73
Cow milk production,[b] kg/d	14.8	13.1	14.3	15.3	13.8	1.0	0.48
Weaning results							
Weaning rate, %	92.3	92.3	100	100	100	4.5	0.49
Weaning age, d	192	193	195	192	192	1	0.15
Average daily gain birth to wean, kg/d	1.07^{a}	$1.10^{a,b}$	1.13^{b}	1.15^{b}	1.07^{a}	0.02	< 0.01
Weaning BW, kg	249^{a}	256^{a}	265^{b}	262^{b}	248^{a}	4	< 0.01

[a] Means with different superscripts (a,b,c) differ ($P < 0.05$).

[b] Cows were evaluated on d 340 of the experiment (63.2 ± 0.5 d after calving). Calves were separated from their dams for 8 h and allowed to suckle for 30 min. Milk yield was calculated as the difference between pre- and post-suckling calf weight. Milk yield was adjusted to 24 h by multiplying the observed difference in pre- and post-suckling calf weight by 3 (Aguiar et al., 2015).

and BCS change during gestation (Bohnert et al., 2002; Currier et al., 2004; Stalker et al., 2006). Nevertheless, lack of BCS group effects on calving parameters observed herein suggest that cow nutritional status across all BCS groups was adequate to sustain the pregnancy and fetal growth (NRC, 2000), despite the designed differences in gestational BCS and BCS change (Table 2).

No BCS group effects were detected ($P \geq 0.49$) for milk yield during the weigh-suckle-weigh evaluation on d 344 (Table 4). Days postpartum was not a significant ($P = 0.20$) covariate for milk yield analysis, which was expected because all cows became pregnant to AI performed on d 0. Moreover, cows were 63.2 ± 0.5 d post-partum on d 344, which corresponds to the peak of lactation in Angus and Hereford cows (Jenkins and Ferrell, 1992). Supporting our findings, Wiley et al. (1991) found no relationship between BCS during gestation and subsequent milk production in first-calf heifers. Spitzer et al. (1995) indicated that cow nutritional status during lactation, but not cow BCS at calving, plays a major role in regulating milk production. Accordingly, the lack of BCS group effects on milk yield herein can be attributed to the similar management that cows were assigned to after immediately calving and during lactation, despite differences detected for BCS change among BCS groups from d 265 to 344 (Table 2).

No BCS group effects were detected ($P \geq 0.15$) for weaning rate and weaning age (Table 4). Similar weaning rate among BCS groups corroborates with calving rate results, given that no calf mortalities were observed from birth to weaning. Moreover, similar weaning age was expected given that all calves were AI-sired, and all cows inseminated on d 0 of the experiment. However, a BCS group effect was detected ($P < 0.01$) for calf ADG from birth to weaning (Table 4). This variable was greater ($P \leq 0.05$) for calves from BCSG2 and BCSG3 cows compared with calves from HBCS and LBCS cows, and similar ($P \geq 0.20$) among all other comparisons. Accordingly, BCS group effects similar to calf ADG were detected ($P < 0.01$) for calf weaning BW (Table 4). Supporting these results, previous research also indicated a positive relationship among cow nutritional status during gestation with offspring weaning performance (Clanton and Zimmerman, 1970; Corah et al., 1975; Bohnert et al., 2013). In addition, the impacts of BCS group on calf performance should not be associated to cow milk production and sire-related effects, given that milk yield was likely similar among all BCS groups and all cows received semen from the same sire. Hence, the greater ADG and weaning BW of calves from BCSG2 and BCSG3 cows are suggestive of fetal programming effects of cow BCS gain during the second and third trimesters of gestation.

Research investigating maternal nutrition during all trimesters of gestation often focuses on nutrient restriction and thus BCS loss. As examples, nutrient restriction during early to mid-gestation impaired fetal growth (Wu et al., 2004), including myogenesis and adipogenesis (Du et al., 2010), as well as organ development and function (Long et al., 2009). In addition, Long et al. (2009, 2010) reported that the negative consequences on offspring productivity caused by nutrient restriction during early gestation can be alleviated if beef cows are re-nourished and gain BCS during late gestation. In the present experiment, BCS during gestation did not decrease among all groups, including LBCS. Therefore, BCS group effects on offspring weaning performance reported herein should be associated with cow BCS maintenance or gain. It is also important to note that all groups, but for HBCS, started the experiment with the BCS typical of postpartum beef cows at breeding (Richards et al., 1986; Cooke and Arthington, 2008). The HBCS group served as positive control for adequate BCS throughout gestation (Kunkle et al., 1994).

Collectively, BCS group effects on weaning variables support our main hypothesis, and suggest that the improved calf performance from cows managed to sustain BCS ≈ 5.5 during the last trimester of gestation observed by Bohnert et al. (2013) should be attributed, at least partially, to the BCS gain of these cows during mid-gestation. Indeed, BCS gain reflects a positive nutritional balance due to a nutrient flushing, which is known to enhance reproductive function in livestock (Dunn and Moss, 1992) and perhaps also has fetal programming effects by increasing nutrient delivery to the developing fetus (Wu et al., 2006). Results from the BCSG2 and BCSG3 groups corroborate with this rationale, as well as with research evaluating cows that are supplemented, and thus gain BCS, during the latter period of gestation (Stalker et al., 2006; Larson et al., 2009; Funston et al., 2012). Alternatively, the similar calf performance from LBCS and HBCS cows are novel and suggest that sustaining BCS in gestating cows, either at levels classically considered inadequate or adequate (Kunkle et al., 1994), has similar fetal programming implications due to the lack of nutrient flushing to the fetus (Dunn and Moss, 1992; Wu et al., 2006). The reason why BCS gain during the first trimester of gestation did not impact offspring productivity compared to BCS gain later in gestation is unknown and deserves investigation. However, BCS gain in typical cow-calf systems is achieved more efficiently during the second and early in the third trimester of gestation, when beef cows are non-lactating and have lessened maintenance requirements (NRC, 2001). Hence, results from this experiment are novel by evaluating BCS maintenance or gain during different periods of gestation, provide insights to future research endeavors investigating the mechanisms by which dam nutrition impacts progeny performance, and have productive implications based on the expected variation in BCS and nutritional requirements of beef cows in commercial cow-calf operations.

4. Conclusion

In this experiment, cows that gained BCS gain during the second and third trimesters of gestation had greater calf weaning BW compared with cohorts that gained BCS during the first trimester or maintained BCS throughout gestation. These outcomes are suggestive of fetal programming because all cows were inseminated with semen from the same sire, were managed similarly after calving, and had similar milk yield during lactation peak. In addition, results from this experiment should not be associated with nutritional deficiencies during gestation, given that BCS was either maintained or increased among all treatment groups. Alternatively, the advantages detected for BCSG2 and BCSG3 cows could be associated with increasing nutrient delivery to the developing fetus (Wu et al., 2006) given that BCS gain reflects a positive nutritional status due to nutrient flushing (Dunn and Moss, 1992). Collectively, results from this research provide novel evidence on how cow BCS gain during gestation impact offspring performance via fetal programming effects, and have productive implications given that lactating beef cows often have BCS ≤ 5 when pregnancy begins (Richards et al., 1986; Kunkle et al., 1994).

Conflict of interest

Nothing to report.

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