

The effect of cow udder score on cow/calf performance in the Nebraska Sandhills

Joslyn K. Beard, Jacki A. Musgrave, Rick N. Funston, and J. Travis Mulliniks¹

West Central Research and Extension Center, University of Nebraska, North Platte, NE 69101

ABSTRACT: Poor udder and teat confirmation decreases profitability due to decreased calf weaning weight, increased incidence of mastitis and labor, and decreased cow lifetime productivity. Therefore, the objective of this retrospective study was to evaluate the effect of beef cow udder score on cow performance and pre- and postweaning progeny performance. In a 5-yr study, crossbred cows at the Gudmundsen Sandhills Laboratory, Whitman, NE, were assigned an udder score each year at calving, from 1 to 5, using an udder and teat combination score. Cows were grouped by udder scores and classified as either low udder score (LUS, udder score 1 or 2; $n = 223$) or high udder score (HUS, udder score 3 or 4; $n = 1,742$). The udder score combines udder conformation and a teat scoring system. Low udder scores consisted of pendulous udders and large teats, whereas HUS consisted of tight udders and small, symmetrical teats. Mixed models were used to evaluate udder score on cow performance and

calf pre- and postweaning performance. Cow body weight (BW) at prebreeding and weaning was greater ($P < 0.01$) in LUS cows compared with HUS counterparts. Pregnancy rate was not different ($P = 0.35$) between udder classification groups. Calf BW at birth ($P = 0.95$), weaning ($P = 0.40$), and adjusted 205-d BW ($P = 0.28$) were not different between udder groups. Cow udder score did not influence feedlot entry ($P = 0.41$) and final BW ($P = 0.30$), dry matter intake ($P = 0.53$), average daily gain ($P = 0.60$), and gain:feed ratio ($P = 0.85$) of steer progeny. However, steers from HUS dams had greater hot carcass weight (HCW; $P = 0.04$) and backfat thickness ($P = 0.02$) compared with LUS counterparts. Results from this study suggest cows with less desirable udder structure may not have a negative impact on calf preweaning growth and performance; however, backfat thickness and HCW in the finishing phase were lower in steers from cows with a lower udder score.

Key words: beef, carcass, udder score, weaning weight

© The Author(s) 2019. Published by Oxford University Press on behalf of the American Society of Animal Science.

All rights reserved. For permissions, please e-mail: journals.permissions@oup.com. This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits non-commercial re-use, distribution, and reproduction in any medium, provided the original work is properly cited. For commercial re-use, please contact journals.permissions@oup.com

Transl. Anim. Sci. 2019.3:14–19
doi: 10.1093/tas/txz006

INTRODUCTION

To improve herd production, producers cull cows based on factors that include reproductive failure, structural issues, progeny performance, and disease. Udder conformation has been indicated as an important factor in cow–calf profitability due to management challenges and reduced

calf performance (Riley et al., 2001). Udder conformation and milk yield can affect calf preweaning average daily gain (ADG; Neville, 1962; Gleddie and Berg, 1968). However, beef cows with poor udder conformation may produce lower calf weaning BW and increase labor costs, leading producers to cull productive cows with mammary problems (Rohrer et al., 1988; Arthur et al., 1992). At calving, cows with poor udder conformation have a greater risk of developing mastitis (DeGroot et al., 2002). Although mastitis is more

¹Corresponding author: travis.mulliniks@unl.edu

Received November 12, 2018.

Accepted February 1, 2019.

prevalent in dairy herds, it does affect 12% to 20% of beef females (Haggard et al., 1983; Watts et al., 1986), which reduces longevity within the cowherd. Research has shown defects in teat shape and size inhibit the calf's nursing ability, thus negatively affecting intake and gain. Frisch (1982) reported a correlation between cows with long teats and high calf mortality. However, that same study concluded calf weaning weight is greater in dam with poor teat conformation due to having greater milk yield. In addition, Edwards et al. (2017) reported milk production level did not influence calf weaning BW or preweaning ADG, which may be due to selection for growth independent of milk production and intake. Data are, however, limited on the effect of udder score on the entire production system from birth to finishing. Thus, we hypothesized that cows classified with LUSs would perform similarly to HUS counterparts and produce calves with similar pre- and postweaning growth. The objective of this study was to evaluate the effect of beef cow udder conformation on cow performance, longevity, and pre- and postweaning progeny performance.

MATERIALS AND METHODS

All animal handling and experimental procedures were conducted to the guidelines of the Institutional Animal Care and Use Committee of the University of Nebraska (IACUC approval number 1474).

Cow-Calf Management

Cow and calf performance data were collected from 2013 through 2017 at the University of Nebraska, Gudmundsen Sandhills Laboratory (GSL), Whitman, NE. Cow and subsequent calf performance were obtained from the March and May calving herds at GSL to determine the effect of cow udder conformation on cow/calf performance and subsequent steer feedlot performance. Cows utilized in this study were Husker Red (5/8 Red Angus, 3/8 Simmental) and ranged from 2 to 11 yr of age under similar management conditions. Each year at calving, two trained technicians recorded udder scores from 1 to 5 as reported in the Integrated Resource Management Guide (Figure 1;

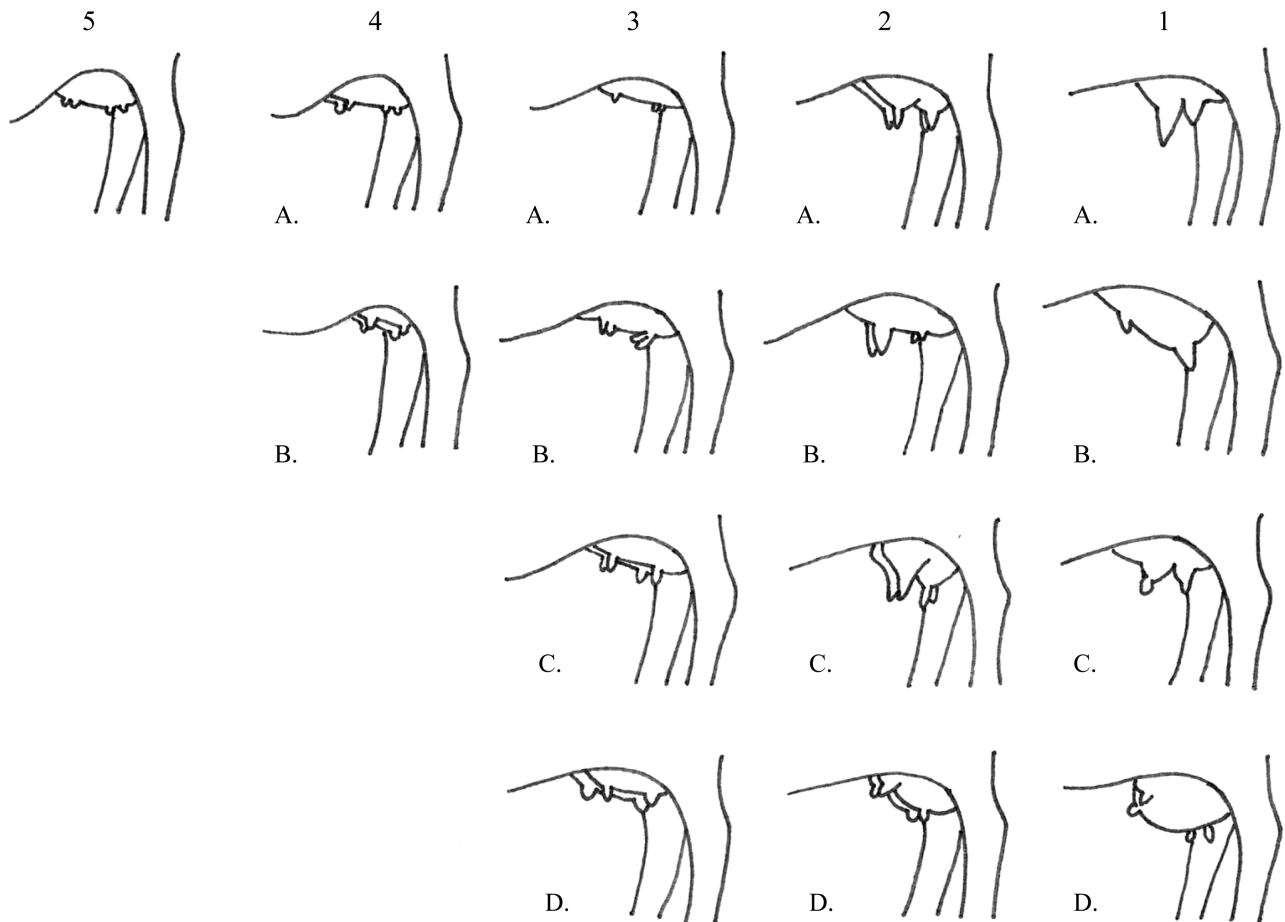


Figure 1. Diagram adapted from the Integrated Resource Management Guide. The system uses a combined udder and teat score system of 1–5, with the acceptance of different appearances depicted as A–D within each score. A score of 5 or 4 is suggested to require no intervention, a score of 3 generally requires no intervention, and a score of 2 or 1 is suggested to require intervention.

National Cattlemen's Beef Association, 2013). The udder score combines udder conformation and a teat scoring system. An udder score of 1 or 2 consisted of pendulous udders and large teats, whereas 3 to 5 consisted of tight udders and small, symmetrical teats. An udder score of 3 would be considered the commercial cow average score. Cows were classified as either low udder score (LUS, udder score 1 or 2; $n = 223$) or high udder score (HUS, udder score 3 or 4; $n = 1,742$). An udder score of 5 was not recorded during the study. Cow body weight (BW) and body condition score (1 = emaciated, 9 = obese; Wagner et al., 1988) were recorded at the initiation of the study (precalving) and again at weaning. All cows across udder score classifications within each calving season were managed similarly from calving to weaning across the years. Calves were weighed at birth and weaning each year. Calf weights at weaning were adjusted to a 205-d age constant BW without adjusting for sex of calf and age of dam. Each year, the cowherd was estrous synchronized with a single injection of PGF_{2 α} (25 mg; Lutelyse; Zoetis Inc.) after 5-d exposure to fertile bulls (bull-to-cow ratio of 1:25) for a 45-d natural breeding season. Pregnancy diagnosis was determined by transrectal ultrasonography by scanning the uteri of cows at weaning each year.

Calves were vaccinated at 2 mo of age with an infectious bovine rhinotracheitis, parainfluenza-3 virus, bovine respiratory syncytial virus, and bovine viral diarrhoea type I and II vaccine (BoviShield 5, Zoetis, Florham Park, NJ). Calves were also weighed, branded, and male calves were castrated. Calves were then moved with cows to native upland range pastures. At weaning, calves were weighed and vaccinated against bovine rotavirus–coronavirus clostridium perfringens types C and D and Escherichia (Bovine Rotavirus-Coronavirus Vaccine Zoetis, Florham Park, NJ). After weaning, March-born steers were placed in a drylot and consumed ad libitum hay for 2 wk post-weaning and were then transported to the West Central Research and Extension Center (WCREC). After weaning, May-born steers grazed subirrigated meadow with 0.45 kg/d supplement or received ad libitum hay with 1.8 kg/d supplement until approximately 1 yr of age and then relocated to WCREC.

Steers were placed in a GrowSafe feeding system (GrowSafe Systems Ltd., Airdrie, AB, Canada) approximately 2 wk after arrival at WCREC. All steer BW was measured on two consecutive days 10 d after GrowSafe entry to allow for acclimation to the feeding system. The average of the 2-d BW was considered the initial feedlot entry BW. At

receiving, steers were fed a diet of 10% dry rolled corn, 45% prairie hay, 40% corn gluten feed, and 5% supplement. The proportions of dry rolled corn and prairie hay changed every 3 to 7 d until acclimating to the finishing diet. Steer calves from both seasons of calving were finished on a common finishing diet of 48% dry rolled corn, 40% corn gluten feed, 7% prairie hay, and 5% supplement. At feedlot entry, all calves were implanted with 14-mg estradiol benzonate and 100-mg trenbolone acetate (Synovex Choice, Zoetis). Approximately 100 d before slaughter, calves were implanted with 28-mg estradiol benzoate and 200-mg trenbolone acetate (Synovex Plus, Zoetis). March-born steer calves were managed similarly during finishing as the May-born calves, all steer calves were fed as a group in drylot pens. Days on feed across the years were 206 ± 2 d. Each year within season of calving herds, steers were sent as a single group to a commercial slaughter facility (Tyson Fresh Meats, Lexington, NE) when estimated visually to have 1.3 cm fat thickness over the 12th rib. Carcass data were collected 24 h post-slaughter, and final BW was calculated from hot carcass weight (HCW) based on an average dressing percentage of 63%. Carcass data included HCW, marbling, yield grade (YG), backfat thickness, and longissimus muscle (LM) area.

Statistical Analysis

Data were analyzed using the PROC MIXED and GLIMMIX procedure of SAS (SAS Inst. Inc., Cary, NC). A mixed model ANOVA accounted for correlations within udder score and udder score within calving season. Models included the effect of treatment, cow age, calving season, and calf sex for all appropriate data. Degrees of freedom were approximated using the Kenward–Roger adjustment. Data are presented as LSMEANS, and P -values ≤ 0.05 were considered significant; tendencies were considered at $P > 0.05$ and $P \leq 0.10$. Data were presented as main effects if interactions were not determined to be statistically significant.

RESULTS AND DISCUSSION

Cow Performance

In many production settings, cows are often culled from udder conformation, which may lead to lack of cow and calf performance data. Low udder score cows had greater prebreeding and weaning BW ($P < 0.01$, Table 1) compared with their HUS

Table 1. Effect of cow udder score on cow and calf performance in Nebraska Sandhills

Measurement	Treatments ¹		SEM	P-value
	LUS	HUS		
Cow BW ² , kg				
Prebreeding	450	428	5	<0.01
Weaning	458	441	5	<0.01
Cow BCS ³				
Prebreeding	5.3	5.2	0.04	0.01
Weaning	5.1	5.4	1.20	0.75
Pregnancy rate, %	83.2	86.9	0.04	0.35
Calf BW, kg				
Birth	32	32	0.5	0.95
Weaning	204	202	3	0.40
Adj. 205 d	154	156	3	0.28

¹Cows were classified as either low udder score (LUS, udder score 1 or 2; $n = 223$) or high udder score (HUS, udder score 3 or 4; $n = 1,742$). The system uses a combined udder and teat score system of 1–5, with the acceptance of different appearances depicted as A–D within each score. A score of 5 or 4 is suggest to require no intervention, a score of 3 generally requires no intervention, and a score of 2 or 1 is suggested to require intervention.

²BW = body weight.

³BCS = body condition score.

counterparts. Cow BW differences may be attributed to variability of cow size and age over the 5-yr period within each udder group. On average, LUS cows were older (5 ± 0.5 yr) than HUS cows (4 ± 0.5 yr), which may have resulted in LUS cows being more mature and having greater BW. With increased age, the udder's medial suspensory ligament can deteriorate, resulting in more outward facing teats and increased cows classified with poor udder conformation (Hickson et al., 2016). Pregnancy rates were not different ($P = 0.35$) between LUS and HUS cows. In agreement, DeNise et al. (1987) reported no relationship between udder size and shape on cow longevity. However, Vukasinovic et al. (1995) reported Brown Swiss cows with better udder and teat scores (1 = worst to 5 = best) had a positive genetic correlation with increased herd longevity, but this may have been due to culling pressure for udder conformation rather than cow performance differences. The occurrence of poor udder cows (LUS) in this study was 11%, which is similar to culling rates of 9.6% to 22% for udder problems from previous studies (Rohrer et al., 1988; Arthur et al., 1992; Riley et al., 2001).

Calf Performance

Calf sex did not affect any of the measured variables ($P \geq 0.10$); thus, heifer and steer data were pooled in all preweaning variables. Udder conformation is considered a functional trait, which may affect cow/calf productivity. If teat and udder conformation limits the ability of a calf to suckle, then udder conformation may limit a calf's genetic potential for growth. Calf BW at birth, weaning,

and adjusted 205-d BW were similar ($P \geq 0.28$; Table 1) between udder score groups. In agreement, Frisch (1982) reported no differences in calf weaning BW due to teat conformation of the dam. This may indicate a lack of relationship between udder conformation and calf growth. Furthermore, in an 8-yr study in Hereford cows, DeNise et al. (1987) reported udder shape did not affect calf growth performance, suggesting cows with udder or teat abnormalities do not hinder calf preweaning growth. In contrast, Goonewardene et al. (2003) reported dams with poor udder conformation weaned lighter calves compared with well-attached udder counterparts. If calf milk intake is limited by udder conformation, calves suckling from LUS dams may depend more on grazing to meet their nutrient requirements. For example, Boggs et al. (1980) reported younger calves that consumed more forage were not consuming enough milk to meet their nutritional needs. Thus, the lack of calf BW at weaning indicates either milk intake was not limited or calf forage intake may have been greater in the LUS calves.

Feedlot Steer Performance

The effect of dam udder score on subsequent offspring feedlot performance is very limited in the literature. Most research on udder conformation on calf performance ends at weaning and not the entire production system. Dam udder score did not influence postweaning steer feedlot entry BW ($P = 0.41$; Table 2), final BW ($P = 0.30$), dry matter intake ($P = 0.53$), ADG ($P = 0.60$), and gain:feed

Table 2. Effect of cow udder score on steer feedlot performance

Measurement	Treatments ¹		SEM	P-value
	LUS	HUS		
Steer BW ² , kg				
Entry	269	276	8	0.41
Final	617	628	10	0.30
Average daily gain, kg/d	1.67	1.70	0.03	0.60
Dry matter intake, kg/d	12.5	12.3	0.25	0.53
Gain:feed ratio, kg/kg	0.14	0.14	0.01	0.85
Carcass characteristics				
Hot carcass weight, kg	375	389	7	0.04
Yield grade	2.3	2.7	0.2	0.10
Longissimus area, cm ²	89.7	90.9	1.9	0.63
Backfat thickness, cm	1.27	1.45	0.08	0.02

¹Cows were classified as either low udder score (LUS, udder score 1 or 2; $n = 223$) or high udder score (HUS, udder score 3 or 4; $n = 1,742$). The system uses a combined udder and teat score system of 1–5, with the acceptance of different appearances depicted as A–D within each score. A score of 5 or 4 is suggest to require no intervention, a score of 3 generally requires no intervention, and a score of 2 or 1 is suggested to require intervention.

²BW = body weight.

ratio (G:F; $P = 0.85$). [Cafe et al. \(2006\)](#) reported cattle entering the feedlot at similar BW performed with similar growth rates, despite being on a slow or rapid rate of gain from birth to weaning. This implies that calves entering the finishing period at similar BW will have similar feedlot performance. This is further supported by [Hennessy and Arthur \(2004\)](#) who reported no differences in ADG between the two groups of cattle (high and low preweaning growth) when entering the feedlot at similar BW.

Carcass Characteristics

Despite having similar finishing BW, calves suckling HUS dams had greater HCW ($P = 0.04$, [Table 2](#)) and backfat thickness ($P = 0.02$). The conflicting results in HCW and finishing BW may have been due to increased variability in final BW from factors such as mud and gut fill. In addition, YG tended to increase ($P = 0.10$) in HUS offspring compared with their LUS counterparts. Similarly, [Stuedemann et al. \(1968\)](#) reported calves suckling dams with various milk yields had similar ADG, G:F HCW, dressing percentages, and YG in the feedlot despite previous treatments. In a meta-analysis, [Lancaster et al. \(2014\)](#) suggested that 94% of the variation in carcass weight is explained by ADG in the yearling phase and entry feedlot BW. Although feedlot entry and final BW were not statistically different between HUS and LUS suckling calves, HUS steers had numerically greater BW, which may have influenced the increased HCW.

IMPLICATIONS

Calves suckling dams classified as having LUSs at calving performed similarly during the preweaning period with their HUS counterparts, with no differences in overall feedlot growth performance between udder groups. However, steers from cows with HUSs did have heavier carcass weights. Further research is required to define the effects of udder score on generational effects of female progeny and how calving season influences the proportion of low udder score cows. However, this study indicated culling cows for poor udder conformation may not be warranted, if calf suckling at birth is not an issue, due to similar postnatal calf performance.

LITERATURE CITED

- Arthur, P.F., M. Makarechian, R.T. Berg, and R. Weingardt. 1992. Reasons for disposal of cows in a purebred Hereford and 2 multibreed synthetic groups under range conditions. *Can. J. Anim. Sci.* 72:751–758. doi:10.4141/cjas92-087
- Boggs, D.L., E.F. Smith, R.R. Schalles, B.E. Brent, L.R. Corah, and R.J. Pruitt. 1980. Effects of milk and forage intake on calf performance. *J. Anim. Sci.* 51:550–553. doi:10.2527/jas1980.513550x
- Cafe, L.M., H. Hearnshaw, D.W. Hennessy, and P.L. Greenwood. 2006. Growth and carcass characteristics of Wagyu-sired steers at heavy market weights following slow or rapid growth to weaning. *Aust. J. Exp. Agric.* 46:951–955. doi:10.1071/EA05372
- DeGroot, B.J., J.F. Keown, L.D. Van Vleck, and E.L. Marotz. 2002. Genetic parameters and responses of linear type, yield traits, and somatic cell scores to divergent selection for predicted transmitting ability for type in Holsteins. *J. Dairy Sci.* 85:1578–1585. doi:10.3168/jds.S0022-0302(02)74227-6

- DeNise, R.S., D.E. Ray, A.M. Lane, V.L. Rundle, and M. Torabi. 1987. Relationships among udder shape, udder capacity, cow longevity and calf weights. *J. Anim. Sci.* 65:366–372. doi:10.2527/jas1987.652366x
- Edwards, S.R., J.D. Hobbs, and J.T. Mulliniks. 2017. High milk production decreases cow-calf productivity within a highly available feed resource environment. *Transl. Anim. Sci.* 1:54–59. doi:10.2527/tas2016.0006
- Frisch, J.E. 1982. The use of teat-size measurements or calf weaning weight as an aid to selection against teat defects in cattle. *Anim. Prod.* 35:127–133. doi:10.1017/S0003356100000891
- Gleddie, V.M., and R.T. Berg. 1968. Milk production in range beef cows and its relationship to calf gains. *Can. J. Anim. Sci.* 4E:323–333.
- Goonewardene, L.A., Z. Wang, M.A. Price, R.C. Yang, R.T. Berg, and M. Makarechian. 2003. Effect of udder type and calving assistance on weaning traits of beef and dairy \times beef calves. *Livest. Prod. Sci.* 81:47–56. doi:10.1016/S0301-6226(02)00194-X
- Haggard, D.L., R.J. Farnsworth, and J.A. Springer. 1983. Subclinical mastitis of beef cows. *J. Am. Vet. Med. Assoc.* 182:604–606.
- Hennessy, D.W., and P.F. Arthur. 2004. The effect of preweaning growth restriction on the feed intake and efficiency of cattle on a grain-based diet before slaughter. *Aust. J. Exp. Agric.* 44:483–488. doi:10.1071/EA02110
- Hickson, R.E., P.J. Back, N.P. Martin, P.R. Kenyon, and S.T. Morris. 2016. The influence of age and breed of cow on colostrum indicators of suckled beef calves. *Proceed. New Zeal. Soc. Anim. Prod.* 76:163–168.
- Lancaster, P.A., C.R. Krehbiel, and G.W. Horn. 2014. A meta-analysis of effects of nutrition and management during the stocker and backgrounding phase on subsequent finishing performance and carcass characteristics. *Prof. Anim. Sci.* 30:602–612. doi:10.15232/pas.2014-01330
- National Cattlemen's Beef Association. 2013. *Integrated Resource Management Redbook*. Centennial, CO.
- Neville, W.F. 1962. Influence of dam's milk production and other factors on 120 and 240 day weight of Hereford calves. *J. Anim. Sci.* 2:315–320. doi:10.2527/jas1962.212315x
- Riley, D.G., J.O. Sanders, R.E. Knutson, and D.K. Lunt. 2001. Comparison of F1 *Bos indicus \times Hereford cows in central Texas: II. Udder, mouth, longevity, and lifetime productivity. *J. Anim. Sci.* 79:1439–1449. doi:10.2527/2001.7961439x*
- Rohrer, G.A., J.F. Baker, C.R. Long, and T.C. Cartwright. 1988. Productive longevity of first-cross cows produced in a five-breed diallel: I. Reasons for removal. *J. Anim. Sci.* 66:2826–2835. doi:10.2527/jas1988.66112826x
- Stuedemann, J.A., J.J. Guenther, S.A. Ewing, R.D. Morrison, and G.V. Odell. 1968. Effect of nutritional level imposed from birth to eight months of age on subsequent growth and development patterns of full-fed beef calves. *J. Anim. Sci.* 27:234–241. doi:10.2527/jas1968.271234x
- Vukasinovic, N., J. Moll, and N. Kunzi. 1995. Genetic relationships among longevity, milk production, and type traits in Swiss Brown cattle. *Livest. Prod. Sci.* 41:11–18. doi:10.1016/0301-6226(94)00044-8
- Wagner, J. J., K.S. Lusby, J.W. Oltjen, J. Rakestraw, R.P. Wettemann, and L.E. Walters. 1988. Body condition at parturition and postpartum weight gain influences luteal activity and concentrations of glucose, insulin, and nonesterified fatty acids in plasma of primiparous beef cows. *J. Anim. Sci.* 76:927–936. doi:10.2527/jas1988.663603x
- Watts, J.L., J.W. Pankey, W.M. Oliver, S.C. Nickerson, and A.W. Lazarus. 1986. Prevalence and effects of intramammary infection in beef cows. *J. Anim. Sci.* 62:16–20. doi:10.2527/jas1986.6211x