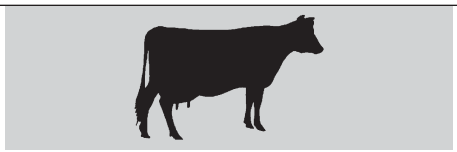
The Professional Animal Scientist 32 (2016):368–374; http://dx.doi.org/10.15232/pas.2015-01443



Case Study: Effect of on-farm dairy Beef Quality Assurance training on selected welfare-related and Beef Quality Assurance–related traits in lactating dairy cows

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ABSTRACT

This pilot study evaluated the effect of on-farm Beef Quality Assurance (BQA) training on welfare- and BQA-related traits in dairy cows and determined practices in place on dairy farms that negatively affected dairy cow welfare and BQA. Twelve dairies participated, with 4 in each category: small (1 to 199 cows); medium (200 to 1,499 cows); and large (1,500 cows or more). Two dairies in each category received BQA training. During 2 visits (before and after training) a survey was administered to identify management practices in place that concern dairy cow welfare and BQA, and an attempt was made to evaluate every lactating cow for BCS and locomotion score. The number of measures in place to avoid residues in the food supply was greater for milk than for meat (3.4 vs. 1.9; $P < 0.01$). Participants reported that injections were administered in each of the following locations: 63.9% neck, 17.3% hind leg, 15.3% upper hip/rump, 3.1% shoulder, and 0.4% tailhead. Because the neck is the only BQA approved location for administering i.m. or s.c. injections, educational efforts are needed to improve injection practices on dairy operations. The percentage of lame and severely lame cows per farm was 14.7 and 3.9% during the pretraining visit and 14.0 and 4.2% during the posttraining visit, respectively. One dairy producer hired a full-time employee to trim hooves and manage lameness on their operation after receiving BQA training. Implementation of an on-farm dairy BQA training has the potential to positively affect dairy cow welfare and BQA practices.

Key words: Beef Quality Assurance, body condition score, dairy cow, locomotion, welfare

INTRODUCTION

Although dairy cows are bred and raised for milk production, most enter the beef supply when culled from the milking herd. Dairy cows are a substantial contributor to the beef supply, with 3,125,000 slaughtered in 2013, accounting for 9.8% of all of the animals slaughtered for beef in the United States (USDA, 2014). The average milking herd culls approximately one-third of their cows annually (Smith et al., 2000; Hadley et al., 2006). The Beef Quality Assurance (**BQA**) program details how practices should be conducted on an operation to ensure that beef products are high quality and safe for consumers (BQA, 2012). Whereas this program has proven successful for the beef cattle industry, it is currently underutilized in the dairy cattle industry.

Many practices that promote BQA also encourage dairy cow welfare.

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Lameness is one of the leading welfare concerns in the dairy industry, with the average prevalence of lameness on dairies ranging from 20 to 55% (Cook, 2003; Espejo et al., 2006; von Keyserlingk et al., 2012). Additionally, lameness is a BQA issue, with dairy cows accounting for the majority of lame cattle that are marketed each year (Ahola et al., 2011a). Early identification of lame cows helps to ensure prompt treatment, increasing the chances of recovery and reducing the risk of sending severely lame animals to slaughter (Whay, 2002; Nordlund et al., 2004).

Since its inception, the BQA program has led to substantial improvements in end product quality and the value of carcasses from fed steers and heifers (NCBA, 2007). Widespread implementation of a dairy BQA program has the potential to markedly improve the welfare of dairy cows and quality of carcasses from market cows. The objectives of this study were to (1) evaluate the effect of on-farm BQA training on welfare- and BQA-related traits in dairy cows, including locomotion score (**LS**) and BCS, and (2) determine practices in place on dairy farms that negatively affect dairy cow welfare and BQA.

MATERIALS AND METHODS

An employee-focused training program was developed to teach core components of the dairy BQA program (NDHIA, 2009), which was facilitated using Spanish-language materials. Topics covered included injection techniques, humane handling, residue prevention, lame cow identification, body condition and locomotion scoring, and management of nonambulatory cows. The training program included a PowerPoint presentation (Microsoft, Redmond, WA), printed information, and a video. The presentation covered how to identify lame cows using a 5-point locomotion scoring system (Sprecher et al., 1997); score the body condition of dairy cows (Wildman et al., 1982; Ferguson et al., 1994); properly handle dairy cows; and properly administer injections. Printed material included the Spanish version of the Idaho dairy BQA manual (Idaho BQA, 2008), the Guidelines for Responsible Antibiotic Use poster in Spanish (MBC, 2013), and the Beef Quality Assurance for Dairy and Beef Farmers poster in Spanish (MBC, 2013). The video that participants watched was the Spanish version of "Prevention and Management of Non-ambulatory Dairy Cows" (WDA, 2010). To determine whether on-farm dairy BQA training had an effect on dairy worker knowledge of BQA and welfare-related practices, pre- and posttraining exam scores were compared for dairy personnel who participated in the training; results of which have been reported (Adams et al., 2016).

A survey was designed to collect information regarding management and housing practices on each dairy that could have an effect on dairy cow welfare and BQA. Questions included lame cow management, euthanasia practices, injection techniques, employee training, sick cow management, and culling practices. Additional questions were included to obtain basic dairy information, including herd size, housing type, and general management practices.

Dairy farms in Colorado and Idaho with a history of collaborating with Colorado State University and the University of Idaho were contacted by extension personnel to participate in this pilot project, with all of those contacted agreeing to participate. Six commercial dairies in each state (n = 12), chosen based on size, agreed to participate. Of the 6 dairies in each state, 2 dairies were chosen to represent each of the following size categories: small (1 to 199 cows); medium (200 to 1,499 cows); and large (1,500 cows or more). In each state, one dairy from each size category was randomly chosen to receive BQA training (n = 6), and the remaining 6 dairies did not receive training. All dairies were visited twice during the study: the pretraining visit occurring in June or July 2013 and the posttraining visit occurring in September or October 2013. The survey was administered to participating dairy producers during both pre- and posttraining visits, with the goal of determining the effect of training on various dairy management practices pertaining to dairy cow welfare and BQA. All lactating cows were observed for LS and BCS during both the pre- and posttraining visits. Cows were scored for LS and BCS by an experienced scorer as they exited the milking parlor using the same systems taught during BQA training sessions. A 5-point LS system was used (Sprecher et al., 1997; 1 = sound, 5 = severely lame), and scores were noted to a whole number. Body condition was scored using a 5-point system (Wildman et al., 1982; Ferguson et al., 1994), where 1 = emaciated and 5 = obese, and scores were noted to the half score. Time constraints did not allow for all lactating cows to be observed on 2 of the dairies during the pretraining visit. For those 2 dairies, the same pens of cows that were observed during the pretraining visit were observed again during the posttraining visit. On dairies that received training, training sessions were conducted with all dairy personnel (including management) concurrent with the pretraining cow evaluation visit.

Data were analyzed using SAS (version 9.3; SAS Institute Inc., Cary, NC). Survey frequency and mean data were calculated using the SURVEYMEANS and SURVEYFREQ procedures. The Wilcoxon Signed Rank and Kruskal Wallis tests for nonparametric data were used to identify differences in participant responses by operation size and by training, as well as to determine the effect of training on LS and BCS, and the prevalence of lame (LS $\geq$3), severely lame (LS $\geq$4), overconditioned (BCS $\geq$4), and underconditioned (BCS $\leq$2) cows, with the EXACT option for small sample sizes being specified in the NPAR1WAY procedure. Descriptive statistics for cow evaluation data were obtained using PROC UNIVARIATE in SAS and reported as the estimate $\pm$SE.

RESULTS AND DISCUSSION

Survey Results

Data are presented for both the pre- and post-BQA training visits when differences were noted; otherwise, data are presented from the pretraining visit only. Mean lactating cow inventory per herd was 134 cows for small (range 102 to 182), 1,231 for medium (range 887 to 1,458), and 2,865 cows for large (range 2,229 to 3,300). The majority of dairies (n = 8) used a combination of free-stalls and dry lots for the primary housing type for their cows, and 4 used dry lots. All of the large- and medium-sized dairies reported milking their cows 3 times per day, whereas all of the small dairies milked their cows 2 times per day.

All of the dairies that participated in the study stated that they offered training to milkers in proper milking techniques. On 7 operations, management was responsible for providing training to milkers, whereas on the remaining 5 dairies, training was provided by both management and extension or industry personnel (n = 2); coworkers in the parlor (n = 1); extension personnel (n = 1); and a combination of management, veterinarians, and extension personnel (n = 1). With the exception of 2 small dairies, all of the operations in the current study relied predominantly on Hispanic workers to carry out the day-to-day tasks on the farm, including milking. In order for a training program to be effective, it needs to be presented in the native language of those attending (Dalton and Jensen, 2006). All 10 of the dairies that relied on Hispanic employees to milk their cows offered the training sessions in Spanish.

Overall, the average milk production was 34.9 ± 1.9 kg/d during the pretraining visit and 35.1 ± 1.6 kg/d during the posttraining visit. The average milk production for small operations was 27.9 ± 4.0 and 29.6 ± 3.3 kg/d for the pre- and posttraining visits, respectively; for medium-sized operations the average milk production was 38.6 ± 0.8 kg/d during the pretraining visit and 37.3 ± 0.6 kg/d during the posttraining visit; and for large operations the average milk production for the pre- and posttraining visits was 38.1 ± 0.7 and 38.4 ± 0.9 kg/d, respectively. This pattern, of increased milk production with increased herd size, agrees with data reported in the NAHMS Dairy 2007 study (USDA, 2007).

The average annual cull rate, excluding deaths, was 31.2 ± 4.5% before training and 35.4 ± 3.4% after training, which was consistent with previous studies (Smith et al., 2000; Hadley et al., 2006). The average annual cull rate for small dairies was 14.0 ± 3.4% during the pretraining visit and 23.3 ± 5.5% during the posttraining visit; for medium dairies it was 39.8 ± 6.9% and 38.9 ± 3.4% for the pre- and posttraining visits, respectively; and for large dairies the average annual cull rate was 39.8 ± 4.3% for the pretraining visit and 44.1 ± 3.2% for the posttraining visit. The average annual cull rate differed among dairy sizes for the pretraining ($P < 0.05$) and posttraining ($P < 0.05$) visits. Participants indicated that an overwhelming 79.8 ± 9.0% of cull cows were sent to market, auction, or a stockyard; 18.0 ± 8.5% were sold directly to the packer or slaughter plant; and 1.8 ± 1.8% were sold to another dairy. These results are similar to those reported in previous studies looking at culling patterns on dairy operations (Rogers et al., 2004; Glaze and Chahine, 2009; Adams et al., 2014). The majority (74.3 ± 8.2%) of cows were culled late in lactation (>200 DIM), with 12.5 ± 6.0% and 12.7 ± 3.6% being culled in early (<50 DIM) and mid lactation (50 to 200 DIM), respectively. The average annual mortality rate on participating dairies was 6.6 ± 1.7% and 8.0 ± 1.6% for the pre- and posttraining visits, with no difference found among dairy sizes. Most death losses (54.1 ± 9.1%) occurred early in lactation; 26.7 ± 7.6% occurred in mid lactation, 15.1 ± 5.1% in late lactation, and 4.2 ± 2.1% in dry cows.

Dairy producers were asked if they had received any condemnations or discounts when marketing cull cows in the 3 mo leading up to the pretraining visit, and in the time between the pre- and posttraining visits. Four dairies reported having at least one cull cow carcass condemned during both the pre- and posttraining visit. The reasons given for condemnations included cancer, pyometra, peritonitis, and sepsis. One respondent in the group that did not receive training reported receiving at least one carcass discount during the pretraining visit, and 4 (2 each in the trained and not trained groups) reported discounts at the posttraining visit. Because many participants sold their market cows through auction markets, it is possible that their cows received a lower price (another form of discount), but a specific defect was never reported to them and they were unaware of it. A study investigating the effect of specific BQA defects on selling price in auction markets in the western United States found that many BQA related characteristics had a negative effect on selling price (Ahola et al., 2011b). For instance, cows with a BCS of 2.5 received, on average, $2.81/45.5 kg less than cows with a BCS of 3.0, and those with a BCS of 2.0 received $5.82/45.5 kg less.

When asked about protective practices in place to prevent milk from cows with a drug residue from making it into the milk supply, small dairies had an average of 2 ± 0.4 practices in place, medium dairies used 3.5 ± 0.3 practices, and large dairies had 4.8 ± 0.5 practices in place. The number of measures in place to protect the milk supply from drug residues differed among operation size ($P < 0.01$). The most common practices were housing cows in a separate pen (n = 11), using written records (n = 10), and physically marking cows (n = 9). Additional methods included using computer records (n = 6), dairy personnel knowing which cows had a milk residue (n = 4), and milking cows with a drug residue in a separate parlor (n = 3). When asked about protective

practices in place to ensure that cows with a meat residue would not make it into the food supply, small dairies had only 1.0 ± 0.0 protective practice in place, medium dairies had 2.5 ± 0.3 practices in place, and large dairies had 2.3 ± 0.5 protective practices in place. Similar to protecting the milk supply, the number of measures in place to protect the meat supply from drug residues differed among operation size ($P < 0.05$). The most common methods used included the use of written records (n = 10) and computer records (n = 8). Additional methods used included housing cows in a separate pen (n = 3), physically marking the cows (n = 1), and dairy personnel knowing which cows had not met their meat withdrawal period (n = 1). It is possible that other methods were in place to protect the milk and meat supply, such as sampling and testing milk or urine from individual cows before marketing their milk or meat, but only the above options were included in the survey. Dairy producers in the current study had more residue prevention measures in place for milk leaving their operations than they had in place for cows that were being marketed for beef ($P < 0.01$). It is likely that producers are more concerned with ensuring that the milk they market is free of all residues because it is their main source of income. Even with fewer procedures in place to ensure that cows are not being marketed with drug residues, none of the dairies surveyed indicated that they had received a condemnation for residues in the past 6 mo, suggesting that they are doing an adequate job of ensuring that cows they sell are meeting this standard.

According to the Animal Medicinal Drug Use Clarification Act of 1994, extralabel use (**ELDU**) is legal for certain approved drugs by a veterinarian or under their direct order (FDA, 1994). The majority (n = 8) of producers in the study stated that extralabel medications were administered on their farms. When asked how withdrawal times were adjusted to account for ELDU, 6 of the 8 respondents indicated that they based their decision on their veterinarian's recommendations. However, of the 2 dairies that did not do this, 1 indicated that they adjusted the withdrawal time based on calculations found online (without providing a source), and the other dairy indicated that days were added to the label withdrawal time based on best estimates by dairy employees. Under the Animal Medicinal Drug Use Clarification Act of 1994, veterinarians are required to label all extralabel drugs with the adjusted withdrawal times for meat and milk from treated animals (FDA, 1994). Because 2 of the dairies in the current study indicated that they determined adjusted withdrawal times for ELDU without their veterinarian's advice, it is apparent that a need exists for producer education on ELDU.

Because a key component of the BQA program is to ensure that all injections are administered to preserve the quality and safety of meat (BQA, 2010), questions were included pertaining to injection practices. The average number of injections administered to an average, healthy cow each year was 16.4 ± 3.7 for participating dairy operations. On average per year, small dairies administered 5.5 ± 0.9 injections, medium gave 24.0 ± 7.9 injections, and large dairies reported 19.8 ± 5.1 injections. The average number of injections administered to each cow annually differed among dairy sizes ($P < 0.05$). This finding is not surprising, as 2 small operations reported only administering antibiotics and vaccines on their dairies, whereas all of the medium and large operations reported administering reproductive hormones, and 3 (2 medium and 1 large) operations reported administering the production hormone bovine somatotropin on their operation. Dairies that administered reproductive or production hormones would be expected to give more injections per year than those that did not, because an estrus synchronization program requires administering between 3 and 5 injections before insemination (Moreira et al., 2001), and bovine somatotropin is typically administered once every 14 d, beginning 57 to 70 DIM and continuing until just before dry-off (Posilac, Elanco Animal Health, Greenfield, IN).

When asked where injections were given, participants reported that 63.9 ± 8.7% were administered in the neck, 17.3 ± 6.2% were given in the hind leg, 15.3 ± 8.5% were administered in the upper hip/rump, 3.1 ± 1.8% were given in the shoulder, and 0.4 ± 0.4% were given in the tailhead. With the neck being the only BQA approved location for administering injections i.m. and s.c. (BQA, 2010), it is apparent that educational efforts are needed to improve injection practices on dairy operations. During the pretraining visit, 56.3 ± 9.8% of injections were administered i.m., 38.4 ± 10.7% were given s.c., and 5.3 ± 2.0% were administered i.v. During the posttraining visit 54.5 ± 10.6% of injections were given i.m., 36.9 ± 10.5% were administered s.c., and 8.6 ± 2.2% were given i.v. Injection practices for the dairies in the current study are presented in Table 1. During both the pre- and posttraining visit, participants stated that the majority of injections were administered i.m. Because many drugs are approved for both i.m. and i.v. administration, or both i.m. and s.c. administration, it is possible that an opportunity exists for dairy producers to reduce the percentage of medications that are administered i.m. and the negative effects this administration route has on dairy BQA. When administering injections, 2 dairies stated that needles were changed after every cow, 5 changed needles after 2 to 5 injections, 2 operations changed after 6 to 10 injections, 1 changed after 11 to 20 injections, and 2 dairies stated that the same needle was used on 20 or more cows before being changed. The BQA program recommends changing needles often (after a maximum of 10 cows) to prevent the needles from becoming dull and contaminated, both of which increase the chances of tissue damage and lesion formation (BQA, 2010). Educating producers on the

Table 1. Distribution of injection practices on 12 dairy operations in Colorado and Idaho, 6 of which received training in Beef Quality Assurance practices, during the pre- and posttraining visits

	Before training			After training		
Injection method	Trained, mean % (±SE)	Not trained, mean % (±SE)	Overall, mean % (±SE)	Trained, mean % (±SE)	Not trained, mean % (±SE)	Overall, mean % (±SE)
Intramuscularly	57.3 (±13.6)	54.7 (±16.1)	56.3 (±9.8)	54.2 (±15.2)	55.0 (±16.2)	54.5 (±10.6)
Subcutaneously	37.3 (±15.5)	40.0 (±15.7)	38.4 (±10.7)	36.5 (±15.0)	37.5 (±16.4)	36.9 (±10.5)
Intravenously	5.3 (±3.3)	5.3 (±1.8)	5.3 (±2.0)	9.3 (±3.7)	7.5 (±1.4)	8.6 (±2.2)

importance of using clean needles will not only improve BQA on their farms, but will also reduce the chance of spreading disease, such as the bovine leukemia virus, within their herd.

During the pretraining visit, a professional hoof trimmer was responsible for trimming hooves on 7 of the participating dairies, and dairy personnel were responsible on the remaining 5 dairies. Between the pre- and posttraining visit, one of the dairy producers who received BQA training decided to hire a full-time employee to provide hoof care on their farm rather than rely on a professional hoof trimmer, stating that the BQA training instilled the importance of early identification and management of lame cows. Hiring a full-time employee can be considered a substantial management decision, indicating that a BQA training program has the potential to encourage significant changes in BQA- and welfare-related practices on dairy operations. Overall, cows visited the hoof trimmer an average of twice per year or lactation on 5 dairies, once per year or lactation on 3 operations, and only when obviously lame or in visible need of trimming on 4 dairies. The average annual percentage of cows that were identified as lame by dairy personnel was 9.5 ± 3.6% during the pretraining visit and 10.9 ± 4.1% for the posttraining visit. Because cows on all operations were evaluated during both the pre- and posttraining visits, it is possible that just having an additional person on the farm evaluating cows for lameness made dairy personnel more aware of lame cows, regardless of whether they received training or not.

Cow Evaluation Results

A total of 28,687 cow observations were made over the course of this study: 14,320 during the pretraining visit and 14,367 during the posttraining visit. The majority of cows were found to be sound or mildly lame, with a locomotion score of 1 or 2 being assigned to an average of 82.4 ± 2.8% of cows on all of the dairies during the pretraining visit and 86.0 ± 1.5% during the posttraining visit (Table 2). During the pretraining visit an average of 14.7 ± 2.8% of cows per farm were found to be lame, of which 3.9 ± 0.9% were classified as severely lame. Similar results were found during the posttraining evaluation, with 14.0 ± 1.5% of cows being lame and 4.2 ± 0.8% being severely lame. The results in the current study are less than those previously reported (Cook, 2003; Espejo et al., 2006; von Keyserlingk et al., 2012). Because the dairies that were chosen to participate in this project were done so because of their relationships with Colorado State University and the University of Idaho, it is possible that they represent dairies that are more proactive when it comes to cow comfort and hoof health. Because this pilot project only included 12 dairies, it is not surprising that differences were not found in the prevalence of lame and severely lame cows between dairies that received BQA training and those that did not. However, the numerical decrease in both lame and severely lame cows over the course of the study for dairies that received training does provide evidence of the potential effect of training programs, such as the BQA training provided in this study, on the prevalence of lame and severely lame cows on dairy operations. Because lameness is one of the leading welfare concerns facing the dairy industry, a need exists for improvement in this area, and producer education and training programs are a sound starting point.

The majority of cows observed during the study were found to be in adequate condition (Table 3), with an average of 82.4% (±2.2) and 78.3% (±2.1) of cows per farm having a BCS of 3.0 or 3.5 during the pre- and posttraining visits, respectively. These results agree with those previously reported by Berry et al. (2007) but are greater than those reported by Loker et al. (2012), where the mean BCS of cows on Canadian farms was 2.68. The Canadian study only included BCS for first lactation heifers, which may explain the discrepancy. The average percentage of underconditioned cows per farm changed 0.3% (±0.2) before training to 0.9% (±0.3) after training, whereas the percentage of overconditioned cows stayed consistent at 0.3% (±0.2) during both visits. It is possible that there was a seasonal effect on BCS over the course of the study (Markusfeld et al., 1997), explaining the decrease in BCS from the summer to the fall. Even with the decrease in BCS over the course of the study, the majority of cows remained in the ideal body condition range, indicating that participating dairies are doing an excellent job at providing their cows with the energy requirements to maintain adequate BCS.

Table 2. Distribution of locomotion scores (LS) for cows on 12 dairy operations in Colorado and Idaho, 6 of which received training in Beef Quality Assurance practices, during the pre- and posttraining evaluations

	Before training			After training		
LS[1]	Trained, mean % (range)	Not trained, mean % (range)	Overall, mean % (range)	Trained, mean % (range)	Not trained, mean % (range)	Overall, mean % (range)
1	60.5 (43.3–82.4)	50.0 (30.7–67.2)	55.3 (30.7–82.4)	63.0 (58.1–73.8)	59.2 (50.4–68.0)	61.1 (50.4–73.8)
2	25.1 (9.4–43.3)	35.0 (21.0–46.5)	30.1 (9.4–46.5)	23.6 (18.4–26.8)	26.2 (17.7–32.1)	24.9 (17.7–32.1)
3	9.5 (2.2–16.7)	12.2 (2.9–22.8)	10.8 (2.2–22.8)	9.0 (2.8–12.7)	10.7 (7.1–16.9)	9.8 (2.8–16.9)
4	4.0 (0.6–7.9)	2.4 (0.0–7.6)	3.2 (0.0–7.9)	3.9 (0.9–6.2)	3.0 (0.9–5.5)	3.5 (0.9–6.2)
5	0.9 (0.0–2.4)	0.4 (0.0–0.9)	0.6 (0.0–2.4)	0.5 (0.0–1.4)	0.9 (0.0–4.5)	0.7 (0.0–4.5)
≥3[2]	14.4 (4.5–24.9)	15.0 (2.9–31.3)	14.7 (2.9–31.3)	13.4 (7.8–18.6)	14.6 (8.3–23.6)	14.0 (7.8–23.6)
≥4[3]	4.9 (0.7–9.7)	2.8 (0.0–8.5)	3.9 (0.0–9.7)	4.4 (1.5–6.9)	3.9 (0.9–10.0)	4.2 (0.9–10.0)

[1]1 = sound, 5 = severely lame (Sprecher et al., 1997).

[2]LS ≥3 was considered lame.

[3]LS ≥4 was considered severely lame.

IMPLICATIONS

Results from this study indicate that implementation of an on-farm BQA training has the potential to result in significant changes in BQA- and welfare-related practices on dairy operations, as evidenced by one dairy hiring a full-time employee to manage lameness. Further investigation is recommended, with a larger sample size and a longer observational period, to determine whether differences observed in dairy cow lameness are due to seasonal effects or BQA training. Further investigation also has the potential to highlight additional BQA- and welfare-related practices that may benefit from on-farm training programs, such as the BQA program in the current study.

Table 3. Distribution of BCS for cows on 12 dairy operations in Colorado and Idaho, 6 of which received training in Beef Quality Assurance practices, during the pre- and posttraining evaluations

	Before training			After training		
BCS[1]	Trained, mean % (range)	Not trained, mean % (range)	Overall, mean % (range)	Trained, mean % (range)	Not trained, mean % (range)	Overall, mean % (range)
≤2.0[2]	0.1 (0.0–0.3)	0.6 (0.0–2.9)	0.3 (0.0–2.9)	0.6 (0.0–1.4)	1.1 (0.1–3.7)	0.9 (0.0–3.7)
2.5	17.4 (7.3–30.7)	16.6 (9.8–26.3)	17.0 (7.3–30.7)	19.7 (13.2–26.8)	21.5 (8.9–32.7)	20.6 (8.9–32.7)
3.0	61.6 (41.6–71.1)	63.2 (57.0–70.7)	62.4 (41.6–71.1)	65.6 (59.7–70.6)	65.5 (55.5–73.4)	65.5 (55.5–73.4)
3.5	20.8 (8.3–27.7)	19.1 (12.8–23.8)	20.0 (8.3–27.7)	13.9 (5.8–19.9)	11.7 (5.3–24.8)	12.8 (5.3–24.8)
≥4.0[3]	0.1 (0.0–0.3)	0.5 (0.0–2.0)	0.3 (0.0–2.0)	0.3 (0.0–0.7)	0.3 (0.0–0.9)	0.3 (0.0–0.9)

[1]1 = emaciated, 5 = obese (Wildman et al., 1982; Ferguson et al., 1994).

[2]BCS ≤2 was considered underconditioned.

[3]BCS ≥4 was considered overconditioned.

ACKNOWLEDGMENTS

The authors thank the dairy producers and their employees for participating in this project. This research was funded in part by cattle producers, through their $1-per-head beef check-off, via the Cattlemen's Beef Board (Centennial, CO) and Idaho Beef Council (Boise).

LITERATURE CITED

Adams, A. E., J. K. Ahola, I. N. Roman-Muniz, and M. Chahine. 2016. Effect of on-farm dairy Beef Quality Assurance (BQA) training on dairy worker knowledge of BQA and welfare related practices. J. Ext. In press.

Adams, A. E., F. J. Olea-Popelka, T. Grandin, D. R. Woerner, and I. N. Roman-Muniz. 2014. Dairy cow handling facilities and the perception of Beef Quality Assurance on Colorado dairies. J. Dairy Sci. 97:798–804.

Ahola, J. K., H. A. Foster, D. L. VanOverbeke, K. S. Jensen, R. L. Wilson, J. B. Glaze Jr., T. E. Fife, C. W. Gray, S. A. Nash, R. R. Panting, and N. R. Rimbey. 2011a. Survey of quality defects in market beef and dairy cows and bulls sold through livestock auction markets in the Western United State: I. Incidence rates. J. Anim. Sci. 89:1474–1483.

Ahola, J. K., H. A. Foster, D. L. VanOverbeke, K. S. Jensen, R. L. Wilson, J. B. Glaze Jr., T. E. Fife, C. W. Gray, S. A. Nash, R. R. Panting, and N. R. Rimbey. 2011b. Quality defects in market beef and dairy cows and bulls sold through livestock auction markets in the Western United States: II. Relative effects on selling price. J. Anim. Sci. 89:1484–1495.

Berry, D. P., F. Buckley, and P. Dillin. 2007. Body condition score and live-weight effects on milk production in Irish Holstein-Friesian cows. Animal 1:1351–1359.

BQA (Beef Quality Assurance). 2010. Dairy Animal Care and Quality Assurance. Natl. Cattlemen's Beef Assoc., Centennial, CO.

BQA (Beef Quality Assurance). 2012. Beef Quality Assurance. National Manual. Natl. Cattlemen's Beef Assoc., Centennial, CO.

Cook, N. B. 2003. Prevalence of lameness among dairy cattle in Wisconsin as a function of housing type and stall surface. J. Am. Vet. Med. Assoc. 223:1324–1328.

Dalton, J. C., and K. S. Jensen. 2006. A Spanish language milker's school for Idaho dairy employees. J. Extension [Online] 44(4). Accessed Jan. 3, 2015. http://www.joe.org/joe/2006august/iw1.php.

Espejo, L. A., M. I. Endres, and J. A. Salfer. 2006. Prevalence of lameness in high-producing Holstein cows housed in freestall barns in Minnesota. J. Dairy Sci. 89:3052–3058.

FDA. 1994. Animal Medical Drug Use Clarification Act of 1994 (AMDUCA). US Food Drug Admin., Silver Spring, MD.

Ferguson, J. D., D. T. Galligan, and N. Thomsen. 1994. Principal descriptor of body condition score in Holstein cows. J. Dairy Sci. 77:2695–2703.

Glaze, J. B., Jr., and M. Chahine. 2009. Assessment of management and basic beef quality assurance practices on Idaho dairies. J. Dairy Sci. 92:1265–1271.

Hadley, G. L., C. A. Wolf, and S. B. Harsh. 2006. Dairy cattle culling patterns, explanations, and implications. J. Dairy Sci. 89:2286–2296.

Idaho BQA. 2008. Beef Quality Assurance—Certification Manual. Idaho Beef Quality Assurance Program. Univ. Idaho Beef Ext., Caldwell, ID.

Loker, S., C. Bastin, F. Migliot, A. Sewalem, L. R. Shaeffer, J. Jamrozik, A. Ali, and V. Osborne. 2012. Genetic and environmental relationships between body condition score and milk production traits in Canadian Holsteins. J. Dairy Sci. 95:410–419.

Markusfeld, O., N. Gallon, and E. Ezra. 1997. Body condition score, health, yield and fertility in dairy cows. Vet. Rec. 141:67–72.

MBC. 2013. Beef Quality Assurance. Minnesota Beef Counc., Maple Plain, MN.

Moreira, F., C. Orlandi, C. A. Risco, R. Mattos, F. Lopes, and W. W. Thatcher. 2001. Effects of presynchronization and bovine somatotropin on pregnancy rates to a timed artificial insemination protocol in lactating dairy cows. J. Dairy Sci. 84:1646–1659.

NCBA. 2007. Executive Summary: National Market Cow and Bull Beef Quality Audit. NCBA's Beef Quality Assurance Program, Natl. Cattlemen's Beef Assoc., Centennial, CO.

NDHIA. 2009. Dairy Animal Care and Quality Assurance Guide. Natl. Dairy Herd Info. Assoc., Verona, WI.

Nordlund, K. V., N. B. Cook, and G. R. Oetzel. 2004. Investigation strategies for laminitis problem herds. J. Dairy Sci. 87(E. Suppl.):E27–E35.

Rogers, C. A., A. C. Fitzgerald, M. A. Carr, B. R. Covey, J. D. Thomas, and M. L. Looper. 2004. On-farm management decisions to improve beef quality of market dairy cows. J. Dairy Sci. 87:1558–1564.

Smith, J. W., L. O. Ely, and A. M. Chapa. 2000. Effect of region, herd size, and milk production on reasons cows leave the herd. J. Dairy Sci. 83:2980–2987.

Sprecher, D. J., D. E. Hostetler, and J. B. Kaneene. 1997. A lameness scoring system that uses posture and gait to predict dairy cattle reproductive performance. Theriogenology 47:1179–1187.

USDA. 2007. Dairy 2007, Part I: Reference of Dairy Cattle Health and Management Practices in the United States, 2007. USDA-Anim. Plant Health Insp. Serv.-Vet. Serv., Center Epidemiol. Anim. Health, Fort Collins, CO.

USDA. 2014. Livestock Slaughter (January 2014). USDA, Natl. Agric. Stat. Serv., Washington, DC. Accessed Aug. 12, 2014. http://www.nass.usda.gov/Publications/Todays_Reports/reports/lstk0114.pdf.

von Keyserlingk, M. A. G., A. Barrientos, K. Ito, E. Galo, and D. M. Weary. 2012. Benchmarking cow comfort on North American freestall dairies: Lameness, leg injuries, lying time, facility design, and management for high-producing Holstein dairy cows. J. Dairy Sci. 95:7399–7408.

WDA. 2010. Prevention and Management of Non-Ambulatory Dairy Cows [Video]. West. Dairy Assoc., Thorton, CO.

Whay, H. 2002. Locomotion scoring and lameness detection in dairy cattle. In Pract. 24:444–449.

Wildman, E. E., G. M. Jones, P. E. Wagnar, H. F. Trout, and T. N. Lesch. 1982. A dairy cow body condition scoring system and its relationship to selected production variables in high producing Holstein dairy cattle. J. Dairy Sci. 65:495–501.