J. Dairy Sci. 97:1–12
http://dx.doi.org/10.3168/jds.2013-7766

Comparison of selected animal observations and management practices used to assess welfare of calves and adult dairy cows on organic and conventional dairy farms

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ABSTRACT

Differences in adoption of selected practices used in welfare assessment and audit programs were contrasted among organic (ORG; n = 192) herds and similarly sized conventional grazing herds (CON-GR; n = 36), and conventional nongrazing herds (CON-NG; n = 64). Criteria from 3 programs were assessed: American Humane Association Animal Welfare Standards for Dairy Cattle, Farmers Assuring Responsible Management (FARM), and the Canadian Codes of Practice (CCP). Data were collected by trained study personnel during a herd visit and included information about neonatal care, dehorning, pain relief, calf nutrition, weaning, record keeping, use of veterinarians, and animal observations. Associations of management type (ORG, CON-GR, or CON-NG) with adoption of selected practice were assessed. Almost all farms (97%) met criteria suggested for age at weaning but fewer CON-NG farmers weaned calves at ≥5 wk of age compared with ORG and CON-GR farmers. Only 23% of farms met program requirements for use of pain relief during dehorning, and fewer CON-NG farmers used pain relief for calves after dehorning compared with ORG and CON-GR farmers. Calves on ORG farms were fed a greater volume of milk and were weaned at an older age than calves on CON-GR and CON-NG farms. Calves on CON-GR farms were dehorned at a younger age compared with calves on ORG and CON-NG farms. The calving area was shared with lactating cows for a larger proportion of ORG herds compared with conventional herds. About 30% of herds met welfare program criteria for body condition score but only about 20% met criteria for animal hygiene scores. The least proportion of cows with hock lesions was observed on ORG farms. Regular use of veterinarians was infrequent for ORG herds. Results of this study indicate that most of the organic and conventional farms enrolled in this study would have been unlikely to achieve many criteria of audit and assessment programs currently used in the US dairy industry.

Key words: organic, management, dairy, welfare

INTRODUCTION

Dairy cattle welfare audits and assessments have been developed to reassure consumers that farmers are using acceptable husbandry practices that result in well-cared-for animals (Reynolds, 2006). Several nongovernmental advocacy groups have encouraged the creation of audits and assessments for animal agriculture (Eicher, 2006). In recent years, restaurant and supermarket chains have begun to require suppliers to provide evidence of acceptable animal management practices on the farms from which they procure products. As a result, several audit and assessment programs for farm animal welfare have been developed. Most programs collect information, such as animal measurements (body condition, lameness, hygiene, and hock lesions), assess farm recordkeeping, and evaluate animal housing and general husbandry. Among auditing and assessment programs, similar information and measurements are commonly assessed but differences in the adoption of management practices and animal measurements among organic and conventional farms have not been previously described.

Auditing and assessment programs typically evaluate management practices that are thought to directly affect animal welfare. Specific areas of concern include the calving environment (Vasseur et al., 2010), management of colostrum (Wells et al., 1996; Weaver et al., 2000; Godden, 2008), mitigation of pain (Faulkner and Weary, 2000), the weaning process (Jasper et al., 2008; Weary et al., 2008), housing environments (Rushen, 2001; Regula et al., 2004; National Farm Animal Care Council, 2009), nutritional management (Burkholder, 2000; Roche et al., 2009), culling, mortality (Thomsen

Received November 25, 2013.
Accepted March 26, 2014.
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and Houe, 2006; Ahlman et al., 2011), and livestock handling practices (Hemsworth et al., 1989, 1995). These practices vary among farms and there are currently no national guidelines for how to assess dairy animal welfare in the United States. The aim of this study was to describe selected animal measurements and adoption of common management practices used to assess and audit animal welfare among organic and conventional dairies in the United States.

MATERIALS AND METHODS

Data Collection

Variables included in this study were selected based on requirements found in 3 common welfare programs. The American Humane Association (**AHA**) Animal Welfare Standards for Dairy Cattle (AHA, 2012) was chosen to represent an audit program. The National Dairy Farm Program (2012) Farmers Assuring Responsible Management (**FARM**) program was chosen to represent an assessment program, and the Canadian National Farm Animal Care Council (2009) Code of Practice (**CCP**) was chosen to represent a uniform industry consensus for ensuring acceptable animal husbandry. Depending on the goal of these programs, they each have individual objectives and collect data including office records, information on employee management and housing, compliance with state and federal milk hygiene regulations, and animal observations. We did not assess all of the items, but among the data collected in these programs, we selected animal-based variables and management practices based on their potential to directly influence dairy animal wellbeing and based on the ability of study personnel to collect these data on farms during scheduled herd visits.

Herd recruitment and data collection have previously been described (Cicconi-Hogan et al., 2013a,b; Richert et al., 2013a,b,c; Stiglbauer et al., 2013). In brief, organic (**ORG**) and similarly sized conventional (**CON**) herds in New York State (n = 72 ORG, 25 CON), Oregon (n = 24 ORG, 24 CON), and Wisconsin (n = 96 ORG, 51 CON) were enrolled between April 2009 and April 2011. Herd eligibility criteria required a minimum of 20 cows and shipping milk to suppliers for at least 2 yr. Organic herds had to be shipping certified organic milk for a minimum of 2 yr. The requirement for a minimum of 2 yr of organic certification was based on recommendations from ORG farmers who wanted to ensure that herd owners had sufficient experience with organic herd management. Herds were categorized into 3 graze categories that combined management system (ORG and CON) and grazing routine. Organic requirements in the United States require lactating cows to obtain ≥30% of DMI from pasture during appropriate seasons. Conventional grazing (**CON-GR**) herds were defined as conventional herds that met this criterion. Conventional nongrazing (**CON-NG**) herds did not meet this definition but still could have allowed cattle to go on pasture. A single farm visit was made by 1 of 3 trained assessors, and a 54-page questionnaire was administered (available at http://milkquality.wisc.edu/organic-dairies/project-c-o-w/). The questionnaire contained information about usage of veterinarians, milk quality protocols, and calf management practices. Information was collected about occurrence of disease, lameness, culling, and veterinary usage during the 60 d before and after the farm visit. In each state, a single member of the study team conducted all interviews and performed all scoring. In addition to the questionnaire, study personnel assessed BCS (Ferguson et al., 1994), udder hygiene score (**UHS**; Schreiner and Ruegg, 2003), hock lesions (Fulwider et al., 2007), and lameness (Sprecher et al., 1997). Animal measurement scores were obtained from all lactating and dry cows for herds up to 50; for larger herds, a randomly selected, representative sample of 20% of lactating and dry cows were scored. Cows were considered lame when lameness score was ≥3, udders were considered dirty when UHS were ≥3. Lameness was scored by adapting the 5-point scale of Sprecher et al. (1997) into dichotomous categories of "lame" or "not lame." Cows that stood with a level-back or slight arch posture and had a normal gait were scored as not lame (scores 1 or 2 according to Sprecher et al. (1997), whereas cows that had an arched-back posture both while standing and walking and had an abnormal gait were scored as lame (scores 3, 4, or 5 according to Sprecher et al., 1997). Before herd visits began, all study personnel met and were trained on administration of the survey instrument and scoring systems used in the study. Throughout the data collection period, monthly conference calls were held to discuss questions and ensure standardization of data collection among states. Study approval was obtained from the Institutional Review Board and Animal Care and Use Committee at Oregon State University.

Statistical Procedures

The herd was the unit of analysis; animal-level measurements were collapsed at the herd level. Descriptive statistics were run using PROC FREQ and PROC UNIVARIATE for categorical and continuous variables, respectively (SAS Institute, 2011). Frequencies were analyzed for associations among graze categories using χ^2 test (PROC FREQ) or Fisher's exact test (when frequencies were <5). Nonparametric means among categories were tested for significant differences using

PROC NPAR1WAY, and differences among means were tested using least significant differences based on the ranks. Statistical significance was defined as $P \leq 0.05$.

RESULTS

Characteristics of enrolled herds have been described previously (Cicconi-Hogan et al., 2013a,b; Richert et al., 2013a,b,c; Stiglbauer et al., 2013). Most herds (72%) contained <100 cows, but 14% of the herds contained 100 to 199 cows and an additional 14% contained >200 cows. Holstein cattle were the predominant breed in 63% of the herds, Jerseys were predominant in 10% of the herds, and crossbred cattle or other breeds predominated in 27% of herds. The average milk yield was 27.9 kg/cow per day. The primary housing for cattle in the 60 d before the herd visit included tiestall barns (26.7%), pasture or drylots (44.9%), group pens (4.5%), or freestall barns (24%). During the 60 d before the herd visit, the time that cattle spent out of the barn was distributed as none (24.6%), 1 to 8 h/d (24.0%), 9 to 19 h/d (16.8%), and 20 to 24 h/d (34.6%)

A variety of management practices for calves were included as requirements in the evaluated welfare programs (Tables 1 and 2). In general, CCP had fewer defined requirements and AHA included the greatest number of defined requirements for calf management. Overall, 61% of farms disinfected navels of newborn calves and we observed no association of this practice with graze category (Table 1; $P = 0.32$). The ability of calves to turn around was observed on 85% of farms and was not associated with graze category ($P = 0.67$). All but 2 farms dehorned calves and, regardless of all graze categories, the use of a hot iron was the most common dehorning method (77%; Table 1). Other dehorning methods included the use of chemical paste (5%) or use of an invasive method such as scoop, gouge, or extraction (18%). Method of dehorning was associated with graze category (Table 1; $P = 0.02$), and a greater proportion of ORG farms used the scoop, gouge, or extraction method compared with CON herds (Table 1). Overall, only 23% of farms utilized traditional methods of pain relief (local anesthetics, analgesics, nonsteroidal antiinflammatories, or sedation). Of ORG farmers, an additional 7% reported using unproven homeopathic remedies for pain relief. A greater proportion of ORG and CON-GR farmers used traditional methods of pain relief compared with CON-NG farmers (Table 1; $P = 0.009$) but fewer CON-NG farmers used the more invasive methods (such as extraction) of dehorning compared with ORG farmers. The areas where cows calved were reported as dedicated calving area, area separated from lactating cows, area shared with sick cows, or area shared with lactating cows. Calving area was significantly associated with graze category ($P = 0.003$). Fewer ORG farms used a dedicated calving pen, and a greater proportion of cows on ORG farms calved in a space that also contained lactating cows (including pastures) (Table 1).

Both the AHA and CCP programs include several defined feeding requirements for calves, whereas the requirements of the FARM program tend to be vaguer (Table 2). With the critical exception of volume of colostrum fed, the majority of farms met requirements for feeding calves. The mean amount of colostrum fed was 2.7, 2.8, and 2.8 L for ORG, CON-GR, and CON-NG, respectively, and was not associated with graze category ($P = 0.90$). Overall, only about half of the farms met AHA requirements for volume of colostrum fed and very few met the greater requirements of the CCP (Table 2). The time until first feeding of colostrum was 4.5, 3.9, and 4.7 h after birth for ORG, CON-GR, and CON-NG, respectively, and the proportion of herds that met welfare program requirements for time until feeding colostrum was not associated with graze category (Table 2; $P = 0.84$). Virtually all farms fed calves milk twice daily and met the stated requirements of the AHA program (Table 2). Greater than 90% of all farms met the AHA program requirements to wean calves at ≥5 wk of age (Table 2). However, age at weaning was greater for calves on ORG farms (11.6 wk) compared with calves on CON-GR (8.3 wk) or calves on CON-NG farms (8.0 wk; $P < 0.001$). Similarly, calves on ORG farms were fed a greater volume of milk compared with calves on conventional dairy farms (5.5, 4.8, and 4.8 L for ORG, CON-GR, and CON-NG, respectively; $P = 0.008$). Although similar proportions of farms met welfare program requirements for age at dehorning (Table 2), calves were dehorned at an older age on ORG (10.2 wk) and CON-NG (9.7 wk) farms compared with calves on CON-GR farms (6.1 wk; $P = 0.03$).

Requirements for body condition, animal hygiene, lameness, and hock lesions were similar for the AHA and FARM programs but were not required by the CCP (Table 3). With the exception of hock lesion scores, a minority of farms met AHA and FARM program requirements for most animal measurements (Table 3). The proportion of herds that met AHA program requirements for maintaining cows with BCS ≤4.5 was greatest for ORG herds and least for CON-NG herds (Table 3; $P < 0.001$). The proportion of herds that met AHA and FARM program requirements for maintaining BCS >2.0 was not associated with graze category (Table 3). We detected no difference in the proportion of herds that met AHA and FARM requirements for UHS (Table 3); the proportion of cows that received UHS of 3 or 4 (indicating dirty udders) was 33.5, 32.9,

Table 1. The proportion of study farms in New York State, Oregon, and Wisconsin that met selected welfare program requirements for calf management

	Requirement of welfare program[1]					Graze category,[2] no. (%)			
Management practice	AHA	FARM	CCP	Criteria or practice evaluated	Overall	ORG (n = 192)	CON-GR (n = 36)	CON-NG (n = 64)	*P*-value
Disinfection of calf navels	Yes	Yes	No	Met requirement	61%	113 (59)	26 (72)	39 (61)	0.32
Weaning age	≥5 wk	No	No	Met requirement	97%	190 (99)	35 (97)	58 (91)	0.006
Ability to turn around[3]	Yes	No	Yes	Met requirement	85%	136 (84)	28 (88)	53 (88)	0.67
Method used to dehorn[4]	Yes[5]	No	No	Chemical paste	5%	7 (4)	6 (17)	3 (5)	0.02
				Hot iron	77%	142 (75)	27 (75)	53 (83)	
				Scoop, gouge, or extraction	18%	40 (21)	3 (8)	8 (12)	
Use of pain relief for dehorning[6]	Yes	Yes	Yes	Local analgesic, NSAID, or sedation	23%	49 (26)	10 (28)	8 (13)	0.009
				Homeopathic	5%	13 (7)	0 (0)	0 (0)	
Calving area[7]	Yes	Yes	Yes	Dedicated maternity area	30%	46 (24)	16 (44)	26 (41)	0.003
				Separate area from lactating cows	18%	39 (20)	2 (6)	13 (20)	
				Separate area that may contain sick cows	14%	23 (12)	6 (17)	11 (17)	
				Area that contains lactating cows	38%	84 (44)	12 (33)	14 (22)	

[1]AHA = American Humane Association (AHA, 2012); FARM = Farmers Assuring Responsible Management (National Dairy Farm Program, 2012); CCP = Canadian Code of Practice (National Farm Animal Care Council, 2009).

[2]ORG = organic farms; CON-GR = conventional grazing farms; CON-NG = conventional nongrazing farms.

[3]Information was available for 162, 32, and 60 ORG, CON-GR, and CON-NG herds, respectively.

[4]Information was available for 189, 36, and 64 ORG, CON-GR, and CON-NG herds, respectively.

[5]Scoop, gouge, or extraction method is not permitted unless performed by a veterinarian with local anesthetic and a nonsteroidal antiinflammatory drug (NSAID).

[6]Information was available for 189, 36, and 63 ORG, CON-GR, and CON-NG herds, respectively.

[7]All programs require a clean environment for calving.

Table 2. Requirements of 3 welfare programs for calf management practices and proportion of study herds located in New York State, Oregon, and Wisconsin that met program requirements, reported by graze category

	Requirement of welfare program[1]				Graze category,[2] frequency (%)			
Variable	AHA	FARM	CCP	Farms that met requirements	ORG (n = 192)	CON-GR (n = 36)	CON-NG (n = 64)	*P*-value
Total amount of colostrum[3]	2–4 L	Adequate amount	4 L	AHA = 50%	88 (52)	13 (40)	31 (48)	0.40
				CCP = 4%	7 (4)	2 (6)	3 (5)	0.82
Time of first colostrum[4]	≤6 h	Soon after birth	≤6 h	AHA = 86% CCP = 86%	159 (85)	28 (88)	56 (88)	0.84
Frequency of feeding milk to preweaned calves[5]	2×/day	No	No	AHA = 99%	178 (98)	36 (100)	63 (100)	0.72
Adequate amount of milk fed to preweaned calves[6]	No	Yes	Yes	FARM = 100% CCP = 100%	189 (100)	36 (100)	63 (100)	1.0
Age at weaning[7]	≥5 wk	No	No	AHA = 98%	190 (100)	35 (97)	58 (92)	<0.001
Age at dehorning[8]	≤8 wk	≤8 wk	No	AHA = 61% FARM = 61%	115 (61)	26 (72)	35 (56)	0.26

[1]AHA = American Humane Association (AHA, 2012); FARM = Farmers Assuring Responsible Management (National Dairy Farm Program, 2012); CCP = Canadian Code of Practice (National Farm Animal Care Council, 2009).

[2]ORG = organic farms; CON-GR = conventional grazing farms; CON-NG = conventional nongrazing farms.

[3]Information was available for 169, 33, and 64 ORG, CON-GR, and CON-NG herds, respectively.

[4]Information was available for 188, 32, and 64 ORG, CON-GR, and CON-NG herds, respectively.

[5]Information was available for 181, 36, and 63 ORG, CON-GR, and CON-NG herds, respectively.

[6]Information was available for 181, 36, and 62 ORG, CON-GR, and CON-NG herds, respectively.

[7]Information was available for 190, 36, and 63 ORG, CON-GR, and CON-NG herds, respectively.

[8]Information was available for 190, 36, and 63 ORG, CON-GR, and CON-NG herds, respectively.

Table 3. Requirements of 3 welfare program for body condition, udder hygiene, lameness, and hock lesions and proportion of study herds located in New York State, Oregon, and Wisconsin that met program requirements, reported by graze category

	Requirement of welfare program[1]				Graze category,[2] no. (%)			
Proportion of cows scored:	AHA	FARM	CCP	Farms that met requirements	ORG (n = 192)	CON-GR (n = 36)	CON-NG (n = 64)	*P*-value
As over-conditioned[3]	98% ≤4.5	No	No	AHA = 31%	71 (37)	11 (31)	8 (13)	<0.001
As under-conditioned[4]	98% >2.0	99% >2.0	No	AHA = 27%	48 (25)	7 (19)	23 (36)	0.13
				FARM = 20%	37 (19)	5 (14)	16 (25)	0.42
With poor udder hygiene[5]	90% ≤2	90% ≤2	No	AHA = 21%	41 (21)	7 (19)	12 (19)	0.89
				FARM = 21%				
As being lame[6]	95% ≤2	95% ≤2	No	AHA = 42%	84 (44)	18 (50)	22 (34)	0.26
				FARM = 42%				
With hock lesions[7]	90% ≤1	95% ≤2	No	AHA = 47%	106 (55)	13 (36)	19 (30)	<0.001
				FARM = 87%	176 (92)	33 (92)	45 (70)	<0.001

[1]AHA = American Humane Association (AHA, 2012); FARM = Farmers Assuring Responsible Management (National Dairy Farm Program, 2012); CCP = Canadian Code of Practice (National Farm Animal Care Council, 2009).

[2]ORG = organic farms; CON-GR = conventional grazing farms; CON-NG = conventional nongrazing farms.

[3]Cows were scored as over-conditioned with BCS ≥4.50 (5-point scale with 0.50 increments).

[4]Cows were scored as under-conditioned with BCS ≤2.20 (5-point scale with 0.50 increments).

[5]Cows were scored as poor hygiene with an udder hygiene score ≥3 (4-point scale).

[6]Cows were scored as being lame with a locomotion score of ≥3 (5-point scale).

[7]Cows were scored as having hock lesions with a hock score of ≥2 (4-point scale).

and 36.0% for ORG, CON-GR, and CON-NG, respectively ($P = 0.72$). Overall, 42% of farms met program requirements that 95% of cows have lameness scores of ≤2 and we detected no association with graze category (Table 3). However, a greater proportion of ORG farms met AHA and FARM program requirements for minimizing hock lesions (Table 3). The proportion of cows observed with hock lesions was least for ORG farms (15.1%) compared with cows in CON-GR (21.8%) and CON-NG (30.5%) herds ($P < 0.001$).

The AHA and FARM programs contain numerous requirements for documentation of protocols and use of veterinarians, whereas the CCP requires only regular use of a veterinarian (Table 4). Compliance with the requirement for written health records was uniformly high but few farms met other requirements in this category (Table 4). A greater proportion of ORG farmers (79%) reported having written treatment records compared with CON-GR (28%) and CON-NG farmers (30%; $P < 0.001$). The proportion of farms reporting regular use of a veterinarian was greater for CON-NG farms (77%) compared with the proportion of CON-GR (56%) and ORG (36%) farms ($P < 0.001$). Only 13% of farmers reported use of veterinarians to train personnel, and this proportion was not associated with graze category (Table 4; $P = 0.31$). The proportion of farmers that used a veterinarian to develop treatment protocols was least for ORG (28%) farms compared with CON-GR (53%) and CON-NG (66%; Table 4; $P < 0.001$). We found no associations of presence of written protocols for clinical mastitis or use of a written milking routine with graze category (Table 4; $P \geq 0.17$).

DISCUSSION

The organic herds included in this study had characteristics that were similar to the majority of organic dairy farms, and the conventional herds included in this study were representative of the large number of relatively smaller herds that predominate in the US dairy industry (USDA-NASS, 2011; Stiglbauer et al., 2013). However, it is important to note that, in 2010, only about 12% of US dairy herds contained >200 dairy cows, but herds in that category produced approximately 74% of all US milk (USDA-NASS, 2011). The herds included in this study were referred to as relatively small herds; the large commercial dairy farms that produce the majority of US milk were purposely not enrolled, because there are relatively few organic herds with >400 cows.

The objective of this study was not to contrast welfare of cows in organic and conventional herds, but rather to describe how organic and similar conventional farms met requirement of programs that are currently used to assess and audit animal welfare among dairies in the United States. Welfare audits provide external validation of compliance with defined standards and are based on a pass or fail system, without providing feedback for improvement. In contrast, welfare assessments are generally considered to be a cooperative effort, with self-assessment possible by either external or internal validation. The goal of assessments is to improve the score through training and awareness. Both dairy animal welfare audits and assessments are designed to assure the consumer that their food comes

Table 4. The proportion of enrolled farms in New York State, Oregon, and Wisconsin with specific welfare audit requirements for records, veterinarian use, and protocols

	Requirement of welfare program[1]				Graze category,[2] no. (%)			
Variable	AHA	FARM	CCP	Overall	ORG (n = 192)	CON-GR (n = 36)	CON-NG (n = 64)	*P*-value
Written health records	Yes	No	No	95%	183 (95)	33 (92)	60 (94)	0.50
Written treatment records	Yes	No	No	62%	151 (79)	10 (28)	19 (30)	<0.001
Regular use of a veterinarian	Yes	Yes	Yes	47%	69 (36)	20 (56)	49 (77)	<0.001
Training of personnel by a veterinarian	Yes	Yes	No	13%	22 (11)	4 (11)	12 (19)	0.31
Protocols developed by a veterinarian	Yes	Yes	No	39%	54 (28)	19 (53)	42 (66)	<0.001
Written protocol for clinical mastitis	Yes	No	No	12%	25 (13)	1 (3)	9 (14)	0.17
Written milking routine	Yes	No	No	15%	28 (15)	5 (14)	11 (17)	0.86

[1]AHA = American Humane Association (AHA, 2012); FARM = Farmers Assuring Responsible Management (National Dairy Farm Program, 2012); CCP = Canadian Code of Practice (National Farm Animal Care Council, 2009).

[2]ORG = organic farms; CON-GR = conventional grazing farms; CON-NG = conventional nongrazing farms.

from animals that have been treated properly (Reynolds, 2006). In the United States, legal requirements for assuring animal welfare are the responsibility of each state, and no national regulations govern farm animal management. In North America, several auditing, assessment, or industry-based consensus programs are used on dairy farms, including the programs evaluated in this study. The AHA program was selected for use in this project as it was the first third-party audit system developed in the United States; the FARM program was selected because it is a popular industry-organized assessment program. As no national regulations exist for dairy management in the United States, the CCP was chosen as being representative of requirements that reflect industry consensus for standards of animal husbandry in Canada. Each program is unique with some similar and some specific areas of emphasis. In the United States, none of these programs are mandatory but farmers who complete a certification process are encouraged to use the program's seal to market products. To become certified, the farm must meet the individual program standards and be audited or assessed annually.

The AHA program audit includes extensive documentation of recordkeeping and employee management. The goals of AHA are to identify corrective actions and develop timetables for improvement of areas that do not comply with animal welfare standards (AHA, 2012). The FARM program is an assessment with second- or third-party verification of a sample of assessed farms. The results are presented to the dairy farmer with the goal of developing an action plan for improvement (when necessary). The FARM program was developed with the use of national dairy check-off funds and is administered by the National Milk Producers Federation (National Dairy Farm Program, 2012). It comprises 36 management checklist points but there is no pass or fail and not all standards are supported by scientific evidence. The CCP for the Care and Handling of Farm Animals for dairy cattle was created by the Canadian National Farm Animal Care Council (2009) with the objective of creating a code that is scientifically informed and practical and that reflects societal expectations for farm animal care. The CCP is not an assessment or audit program, but can be used as a reference for legal regulations and recommended best management practices. Although these programs are widely used, their relationship with and ability to influence dairy cattle welfare is unknown. These programs were selected for this study because they are representative of audits, assessments, and an industry-based consensus program. Each program has an extensive number of variables and observations that are evaluated. The variables selected from these programs to compare in this study were those that could be expected to directly influence dairy cattle wellbeing.

Auditing and assessment programs commonly include requirements for veterinary involvement, animal health and management, humane handling of cattle, stockperson training, housing, feeding, and transportation (National Farm Animal Care Council, 2009; AHA, 2012; National Dairy Farm Program, 2012). The role of the veterinarian in providing animal health care is typically emphasized. However, research (using the same data set as used in the current project) has demonstrated that most animal diseases are diagnosed and treated without input by veterinarians (Richert et al., 2013c). Auditing and assessment programs also commonly enforce the importance of having an animal health plan (National Farm Animal Care Council, 2009; AHA, 2012; National Dairy Farm Program, 2012). The AHA program requires that a health plan is developed in consultation with the herd veterinarian and specifies that the plan must include vaccination and treatment protocols, tolerance limits for overall morbidity, descriptions of causes of morbidity and mor-

tality, biosecurity measures for new animals entering the herd, action plans to remedy problems and mitigate recurring injuries, mastitis control, and monitoring of herd performance. The FARM program requires that farmers work with a herd veterinarian to develop an animal health plan that is reviewed and updated annually. The herd health plan must include protocols for vaccinations, daily observations of all cattle for injuries or signs of disease, newborn calf management, milk-fed calf management, painful procedures, dystocia, prevention and detection of common diseases, parasites and pest control, fly control, nonambulatory animal management, food safety, and training programs for animal caretakers. The CCP does not require a herd health plan; however, appropriate authorities are to be advised of any suspected or confirmed cases of reportable disease, appropriate drug withdrawal times must be observed, and feet must be inspected and trimmed as required. Only a minority of farms that participated in this study would have met the requirements for regular use of veterinarians and development of an annual herd health plan (Table 4). Only 47% of farmers reported regular use of veterinarians, and ORG farmers were the least likely to comply with this requirement. Protocols were developed by veterinarians on only 39% of farms, and personnel were trained by a veterinarian on very few farms (13%). Richert et al. (2013c) reported that use of veterinarians was more strongly associated with adoption of intensive management practices (such as use of a nutritionist, use of AI, having cows checked for pregnancy, and use of vaccinations) compared with adoption of organic management strategies. During the 120-d data collection period, regularly scheduled veterinary visits occurred on only 40% of farms that participated in this study (Richert et al., 2013c). Previous research has also documented that few farmers actively consult their veterinarians for improvement of milk quality (Rodrigues et al., 2005). The role of veterinarians on relatively small dairy farms is likely restricted due to labor and financial concerns (Richert et al., 2013c), and strengthening this relationship is needed to meet the requirements of these audit and assessment programs.

Mastitis is the most common disease in dairy cattle and can negatively affect welfare (Leslie and Petersson-Wolfe, 2012). Neither the FARM program nor the CCP has a specific requirement for the control of mastitis. However, the AHA program requires a written policy specifying that all cases of mastitis must be identified and treated. In addition, SCC must be monitored at the bulk tank level and when it exceeds 375,000 cells/mL for any 2-mo period, the etiology of infections must be determined and an appropriate control program must be initiated. The AHA program also includes requirements for having a written treatment protocol for mastitis as well as a written milking routine (Table 4). Consistent with previous research (Rodrigues et al., 2005), few of the farms enrolled in the current study had written treatment protocols or written milking routines. Therefore, at least 75% of these farms would not have met the AHA criteria for a mastitis control plan. The inclusion of these requirements may be a disadvantage for operators of smaller farms, as the owners often perform many of the tasks themselves and may be too busy or not see the need to complete office-based work such as drafting written protocols.

Many management practices can influence calf welfare, including location of birth, management of colostrum, care of preweaned calves, and weaning management. The location of birth can increase the risk of disease, especially if a calf is exposed to a nonhygienic environment (Lago et al., 2006). All of the welfare programs evaluated in this study included a requirement for a clean calving area but the exact type of calving area is not usually specified. A variety of areas were used for calving by herds enrolled in this study (Table 1). A greater proportion of CON farms contained a dedicated maternity pen compared with ORG farms, and more ORG farms calved cows in areas that also contained lactating cows. During the peripartum period, cows are often immunosuppressed, and biosecurity guidelines stress separation of these cows from ill animals. However, smaller dairy farms often have very limited facilities and about 14% of the farms included in this study reported that calving occurred in the same area that housed sick cattle.

Disinfection of navels of neonatal calves is a recommended practice that is reported to decrease the risk of infection (Mee, 2008). Both the AHA and FARM programs have requirements for disinfection of calf navels (Table 1). The CCP criteria recommend disinfection of navels but do not include a specific requirement. Although this practice was not associated with graze category, only 61% of farms that participated in this study would have met this criterion.

Calves are born with limited immunity and the importance of timely feeding a sufficient quantity of high quality colostrum is well known (Weaver et al., 2000; Godden, 2008; Vasseur et al., 2010). All 3 auditing and assessment programs have requirements for consumption of colostrum but the amount of colostrum required varies among the programs. In the current study, although colostrum was fed in a timely manner, most herds did not feed sufficient quantities to meet program requirements (Table 2), potentially increasing disease risks of calves. The failure to meet program requirements was most dramatic for the CCP as only about

4% of herds would have met the requirements of this program.

Feeding calves a greater quantity of milk per day has been associated with increased growth rates, accelerated age at first calving, improved mammary development, and increased milking production during the first lactation (Jasper and Weary, 2002; Rincker et al., 2006). The AHA and FARM programs include requirements for consumption of milk and water, whereas the CCP includes requirements only for milk consumption (Table 1). Although the amount of milk fed daily differed significantly among graze categories, the volume fed was sufficient to meet requirements of all programs, and the average number of feedings per day would have met the AHA criteria. Organic farmers fed a greater volume of milk but calves were weaned later, thus more of the nutritional requirements for calves on ORG farms would have had to be met by milk rather than solid feeds.

Weaning is a potentially stressful feeding transition for young calves (Weary et al., 2008; Vasseur et al., 2010). To minimize stress, weaning should be performed gradually and be based on the ability to consume solid food rather than be based strictly on age (Jasper et al., 2008; Weary et al., 2008; Vasseur et al., 2010). According to USDA (2010), only about 10% of US dairy herds wean calves at $\leq$5 wk. Of the 3 programs evaluated in this study, only AHA required feeding milk until calves are at least 5 wk of age (Table 1). Overall, 97% of herds would have met this requirement, but a greater proportion of ORG herds met this requirement compared with CON-NG herds.

Depending on the circumstances of the individual farm, calves can be housed in many different types of environments. In the United States, most preweaned calves are housed in individual pens or hutches or multi-animal pens (USDA, 2010). Although each of the 3 audit and assessment programs includes general recommendations for calf housing, the AHA and CCP programs have requirements that calves have the freedom to stand up, turn around, and lie down (Table 1). This requirement was met by 85% of the farms in this study and there was no association with graze category.

Several common husbandry procedures have the potential to cause pain, but dehorning is probably the most potentially painful management practice performed on young calves. All 3 programs have some requirements for dehorning procedures that specify preferred method, use of pain control, and the preferred maximum age at dehorning (Tables 1 and 2). The AHA program prohibits dehorning at >4 mo of age unless anesthetics are administered, the FARM program promotes disbudding at the earliest age possible, and the CCP promotes the use of disbudding at <3 wk of age. Of herds included in this study, about 61% met dehorning age requirements specified by FARM and AHA (Table 2). For farms in all graze categories, the use of a hot iron was the most common method of dehorning (Table 1). In addition, the scoop, gouge, or extraction method was used on 17% of farms. Data from USDA (2010) has previously indicated that <20% of dairy herds utilize analgesics or anesthetics while dehorning. Similarly, only 23% of the farms included in the current study would have met requirements for mitigation of pain that are specified by the 3 welfare programs, and CON-NG farms were least likely to use pain relief during dehorning. Results of this study indicate a pressing need for educational programs that promote improved methods of dehorning and pain management. Increased involvement of veterinarians may be one method to improve compliance with this requirement.

Animal-based observations are commonly used in audit and assessment programs to objectively evaluate specific outcomes of cattle housing and management. Improperly designed or maintained animal facilities may result in an excessive number of lame or injured cows (Rushen, 2001), excessive number of cows with hock lesions (Regula et al., 2004; Rutherford et al., 2008), cows that exhibit abnormal behaviors (Haley et al., 2000; Blackie et al., 2011), or cows that are excessively dirty (Regula et al., 2004). Of the 3 evaluated programs, AHA has 9 animal-based measures, including udder condition, incidence of slips, incidence of falls, scores for lameness, hygiene, leg condition (hock), coat condition, tail condition, and body condition. In comparison, the FARM program has 4 animal-based measures, including body condition, lameness, hock lesions, and hygiene. Because the CCP is neither an audit nor an assessment program, no specific animal-based measures are required, although the program specifies that lame cows should be diagnosed early and cared for appropriately. Producers are also instructed to take corrective action for animals with BCS of $\leq$2.0. Although the manual for each of these scoring systems includes instructions on how to perform scoring, comparability of the results depends on the training of the assessors relative to application of the scoring criteria. In the current study, university personnel were co-trained to perform scoring of body condition, udder hygiene, and hocks for most or all cows present in the enrolled herds.

The AHA program requires that 100% of lactating and dry cows are scored for lameness and no more than 5% of scores may exceed 2 (using a 5-point scale); the FARM program requires that no more than 5% of scores can exceed 2 but uses a 3-point scale. The prevalence of lameness observed for cattle in herds enrolled in this study (Richert et al., 2013b) was less than previously observed in studies that have used larger, more

intensively managed herds (Cook, 2003; Fulwider et al., 2008) but only 43% of enrolled herds would have met the FARM and AHA requirements for lameness scores. Richert et al. (2013b) previously reported that farmers enrolled in this study perceived less lameness than was observed by study personnel; thus, improved awareness of lameness is necessary to implement effective preventive management programs.

Animal hygiene requirements for the AHA and FARM programs specify that 90% of all cows must have a hygiene score <3 (using a 4-point scale); however, each program has specific criteria for determining which body areas are scored. The scoring process for both programs is inclusive of legs, belly, and udders; however, the assessor must arrive at a single score for hygiene of each cow. Regardless of what body parts are scored for hygiene, it is highly unlikely that many herds would be able to achieve these program criteria. In the current study, UHS were used to assess animal hygiene. Previous research has demonstrated that UHS are highly correlated with hygiene of legs and thus, in many instances, are representative of overall hygiene of the cow (Schreiner and Ruegg, 2003). Only 21% of herds enrolled in the current study met the requirements of the evaluated programs, and the average proportion of cows with UHS >2 exceeded 30% for all graze categories (Table 3). This finding was consistent with previous research that performed UHS on cows of 8 Wisconsin dairy farms (Schreiner and Ruegg, 2003). Better hygiene was observed for a comprehensive study that performed UHS for cows on 100 farms located in Wisconsin, Minnesota, Indiana, Iowa, and New York (Fulwider et al., 2007). In that study, the average percentage of cows with UHS >2 was about 15%, regardless of type of bedding used in the dairy facilities (Fulwider et al., 2007). Improving hygiene scores is based on using more bedding, providing sufficient dry lying areas for cows, and ensuring that cow lanes and alleys are clean and free of mud. These investments in improved hygiene can be cost effective as cows with cleaner udders have been shown to have a reduced incidence of mastitis (Schreiner and Ruegg, 2003).

The leg condition score used by the AHA program is a 4-point scale and the program requires 90% of lactating cows to have leg condition score of ≤1. In addition, scores of 1, 2, or 3 may not exceed 10% and scores of 2 or 3 cannot exceed 2% of all lactating cows. The FARM program requires 95% of the herd to have a hock score of ≤2 (on a 3-point scale). In these herds, only 36 to 47% of farms would have achieved these criteria (Table 3). Even herds that used intensive grazing (CON-GR) had a greater proportion of cows observed with hock lesions compared with cows on ORG farms (Table 3). The proportion of hock lesions observed in the current study was similar to that reported by Lombard et al. (2010) for cows housed in freestalls. About 27% of farms included in the current study were housed in tiestall barns, which would be considered to create a greater risk of hock lesions. However, about 25% of cows housed on bedded packs in Minnesota were reported to have hock scores ≥2 (Barberg, et al., 2007), thus other risk factors do exist.

The effect of nutritional management is commonly measured using BCS (Roche et al., 2009). The AHA program requires body condition to be measured using a 5-point scale (Edmonson et al., 1989) and requires that ≥98% of the lactating cows must have a BCS between 2.0 and 4.5. The FARM program requires that ≥99% of cows must have a BCS that exceeds 2.0. These criteria are difficult to achieve in small herds as the occurrence of 1 or 2 animals outside of the optimal range in a herd of 50 to 90 cows may cause the farm to fail this criterion. Although CON-NG herds had the least proportion of cows scored as being under-conditioned (≤2.0), most farms of all graze categories did not meet the minimum requirements of either the AHA or the FARM program. In addition, CON-GR and ORG had the least proportion of cows scored as being over-conditioned (≥4) and exceeded the minimum requirements for the AHA. It is reasonable for welfare programs to consider BCS as a criterion but the scientific basis for realistic thresholds should be reconsidered.

CONCLUSIONS

Management practices and animal-based measures from organic and conventional dairy farms were compared with selected requirements of 3 welfare programs. Most of the small farms represented in this population would not have met many requirements. The greatest compliance was for nutritional management of calves, and the least compliance was observed for use of pain relief for dehorning, training of farm personnel by veterinarians, and presence of written protocols. The regular use of veterinarians was minimal, although CON-NG herds had the greatest proportion of farmers that reported regular use of veterinarians. Several criteria for animal-based measurements were met by a minority of farms. As this study shows, many of the relatively smaller farms included in this study were not likely to achieve many of the requirements made in common welfare programs. The actual ability of these program requirements to influence animal welfare is unknown.

ACKNOWLEDGMENTS

Data collection for this study was funded by the USDA National Institute of Food and Agriculture

(Washington, DC) project 2008-51106-19463. Support for M. A. Bergman was provided by USDA Multistate Formula Funds WISO 1591.

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