The Veterinary Journal 199 (2014) 184–187

Contents lists available at ScienceDirect

The Veterinary Journal

journal homepage: www.elsevier.com/locate/tvjl

Short Communication

Does milk yield reflect the level of welfare in dairy herds?

Maud Coignard [a,b,*], Raphaël Guatteo [a,b], Isabelle Veissier [c,d], Anne Lehébel [a], Charlotte Hoogveld [b], Luc Mounier [c,d], Nathalie Bareille [a,b]

[a] INRA, UMR 1300, Biology, Epidemiology and Risk Analysis in Animal Health, CS 40706, F-44307 Nantes, France
[b] LUNAM Université, Oniris, Nantes-Atlantic College of Veterinary Medicine, Food Sciences and Engineering, UMR BioEpAR, F-44307 Nantes, France
[c] Université de Lyon, VetAgro Sup, UMR 1213 Herbivores, F-69280 Marcy L'Etoile, France
[d] INRA, UMR 1213 Herbivores, F-63122 Saint-Genès-Champanelle, France

ARTICLE INFO

Article history:
Accepted 9 October 2013

Keywords:
Dairy herd
Welfare
Milk production

ABSTRACT

Under the assumption that milk yield may be reduced in herds with impaired welfare, the present study aimed at investigating whether milk yield could be used as a reliable indicator of welfare. In 125 commercial French dairy herds, the association between the welfare of the herd (evaluated using the Welfare Quality assessment protocol) and cow milk yield was investigated using linear mixed models. Positive associations were identified between milk yield and low aggressions between cows and good emotional state of the herd but there was a negative association with good health assessed through the occurrence of diseases and injuries. These opposite associations resulted in no association with the overall welfare of the herd. Milk yield should not therefore be used as an indicator of overall welfare.

There is a growing concern for welfare in farm animals including cattle. Among the different components of welfare (health, feeding, housing and behaviour), the European Food Safety Authority reported that dairy cows are especially affected by poor health (EFSA Reports, 2009). To improve animal welfare at the population level, it is essential to be able to identify farms with impaired welfare in order to prioritize intervention plans. Some health disorders (such as lameness and dystocia) have a negative impact on milk yield in dairy cows (Fourichon et al., 1999). Thus, we can assume that milk yield might be used to detect farms with impaired welfare (de Vries et al., 2011). Moreover, a positive association between milk yield and the welfare of dairy herds would bring a strong economic argument to encourage dairy farmers to adopt welfare plans. The objective of this study was to investigate whether the welfare of the herd could influence milk yield in dairy cows.

The Welfare Quality assessment protocol was performed on 125 commercial dairy farms by five trained observers between December 2010 and March 2011. The selected protocol assesses all aspects of welfare in a single 1-day visit and leads to expert-based welfare scores (on a 0–100 value scale) that measure 11 farm-level welfare criteria.[1] The strength of this protocol relies on the assessment through the collection of a large panel of animals and environment based-measures (33). The data are combined at the herd level to calculate the 11 welfare criterion-scores. Then, these criterion-scores are combined to calculate scores for four principles (see list of welfare principles and criteria in Tables 2 and 3). In a final step, the four principle-scores are used to assign the farm to one of four categories: excellent, enhanced, acceptable and not classified (more details are available on the website).[1] For each step of the calculation process, experts made the choice not to allow compensation between scores because they considered that good welfare cannot be reached if one of the measures is clearly impaired.

We also calculated the mean of the four principle-scores to obtain an overall score for each farm expressed on a continuous scale. For each cow of each herd, test-day milk yields collected between the interval [−30; +30] days around the farm visit were extracted from the national milk-recording database. As none of the welfare scores fulfilled the linearity of effect assumption with the milk yield of dairy cows, they were each gathered into classes according to quartiles of their respective distributions. The first category corresponded to the worst scores (less than or equal to the first quartile) and the second category corresponded to the others (above the first quartile). The association between cow test-day milk yield and each of the 16 welfare scores (1 overall score, 4 principle- and 11 criterion-scores) was analyzed using the following formula:

$$TDY_{ijt} = \mu + score_{s(j)} + parity_k + \beta_1 \times DIM + \beta_2 \times \exp(-0.05 \times DIM) + MC_l + breed_m + MPL_n + u_j + \varepsilon_{ijt},$$

with

* Corresponding author at: INRA, UMR 1300 Biology, Epidemiology and Risk Analysis in Animal Health, CS 40706, F-44307 Nantes, France. Tel.: +33 240 68 76 74.
E-mail address: maud.coignard@oniris-nantes.fr (M. Coignard).

[1] See: http://www.welfarequality.net/network/45848/7/0/40.

1090-0233/$ - see front matter © 2013 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.tvjl.2013.10.011

Table 1
Association between the overall welfare score (herd level) and cow-level confounders with test-day milk yield in the linear mixed model in 125 French dairy herds.

Variable	Number of test-day milk yield included in the model	Estimated value[a] (kg/day)	SE	*P*-value
Intercept		*35.62*	*0.59*	*<0.0001*
Overall welfare score				**0.06**
⩽37.4	3063	1.36	0.72	
>37.4	7316	Reference		
Parity				<0.0001
Parity 1	3601	−4.42	0.17	
Parity 2	2439	−1.39	0.18	
Parity 3	1836	−0.61	0.20	
Parity ⩾4	2704	Reference		
Days in milk at milk recording	10,580	−0.04	0.00	<0.0001
Wilmink function (exp − 0.05 ∗ days in milk at milk recording)	10,580	−5.66	0.44	<0.0001
Season of milk yield recording				<0.0001
January	3416	0.53	0.13	
February	3625	0.75	0.15	
March to April	1505	1.13	0.18	
November to December	2034	Reference		
Breed				<0.0001
Montbeliarde	5275	−0.86	0.46	
Holstein	5036	2.35	0.45	
Other (Abondance; Crossbreed)	269	Reference		
Milk production level within herd adjusted for breed and parity (kg/lactation)[b]				<0.0001
Low	3697	−5.01	0.16	
Medium	3540	−2.52	0.16	
High	3343	Reference		

[a] Estimated value of the intercept: Mean milk production for a cow in the reference population (overall welfare score of the herd >37.4, cow parity ⩾4, milk yield recording from November to December, Abondance or Crossbreed cow and cow with high milk production level within herd adjusted for breed and parity). The estimated value of the overall welfare score indicates that cow in herds with lowest score produce on average 1.36 kg/day more than cow in herds with highest score.
[b] Based on milk production level during the preceding 305-day lactation for multiparous cows and on the maximum of milk yield recorded during the first 3 months of the current lactation for primiparous cows. The thresholds of three categories were defined by terciles, for each parity and breed.

Table 2
Association between the four welfare principle-scores and test-day milk yield assessed through four separate linear mixed models using the Welfare Quality assessment protocol in 125 French dairy herds.

Welfare principles	Number of test-day milk yield included in the models	Estimated value[a] (kg/day)	SE	*P*-value
Good feeding				**0.83**
Intercept		*38.55*	*0.61*	*<0.0001*
⩽14.6	2910	0.16	0.75	
>14.6	7670	Reference		
Good housing				**0.79**
Intercept		*38.54*	*0.61*	*<0.0001*
⩽51.7	2797	0.20	0.76	
>51.7	7783	Reference		
Good health				**0.002**
Intercept		*38.01*	*0.61*	*<0.0001*
⩽27.7	2896	2.28	0.74	
>27.7	7684	Reference		
Appropriate behaviour				**0.72**
Intercept		*36.02*	*0.60*	*<0.0001*
⩽28.4	2739	−0.25	0.70	
>28.4	7640	Reference		

[a] For each model, the estimated value of the intercept was the mean milk production for a cow in the reference population (welfare principle score of the herd above each given threshold, cow parity ⩾4, milk yield recording from November to December, Abondance or Crossbreed cow and cow with high milk production level within herd adjusted for breed and parity).

$$\varepsilon_{ijt} = \varphi * \epsilon_{ij(t-1)} + \eta_{lijt},$$

$$\eta_{ijt} \sim N(0, \sigma_R),$$

$$U_j \sim N(0, \sigma_u),$$

where TDY_{ijt} = milk yield of cow i from farm j on test-day t; μ = average milk yield of cow on test-day (intercept); $score_{s(j)}$ = welfare score for a given principle or criterion; $parity_k$ = parity of cow, $k \in (1; \geqslant 4)$; DIM = days in milk of cow; $\beta_1 \times DIM + \beta_2 \times \exp(-0.05 \times DIM)$ = Wilmink function to adjust the milk production curve; MC_l = season of milk yield recorded, $l \in$ (January; February; March to April; November to December); $breed_m$ = breed for cow, $m \in$ (Montbeliarde; Holstein, Other); MPL_n = milk production level within herd adjusted for breed and parity, $n \in$ (Low; Medium; High); u_j = random effect related to the herd; ε_{ijt} = residual error with an order 1 autoregressive autocorrelation structure. The significance threshold was set at $P = 0.05$.