J. Dairy Sci. 97:1082–1091
http://dx.doi.org/10.3168/jds.2013-6578

Factors associated with age at slaughter and carcass weight, price, and value of dairy cull cows

I. Bazzoli,* M. De Marchi,*[1] A. Cecchinato,* D. P. Berry,† and G. Bittante*
*Department of Agronomy, Food, Natural Resources, Animals, and Environment (DAFNAE), University of Padova, Viale dell'Università 16, 35020 Legnaro (PD), Italy
†Animal and Grassland Research and Innovation Centre, Teagasc, Moorepark, Co. Cork, Ireland

ABSTRACT

The sale of cull cows contributes to the overall profit of dairy herds. The objective of this study was to quantify the factors associated with slaughter age (mo), cow carcass weight (kg), price (€/kg of carcass weight), and value (€/head) of dairy cull cows. Data included 20,995 slaughter records in the period from 2003 to 2011 of 5 different breeds: 2 dairy [Holstein Friesian (HF) and Brown Swiss (BS)] and 3 dual-purpose [Simmental (Si), Alpine Grey (AG), and Rendena (Re)]. Associations of breed, age of cow (except when the dependent variable was slaughter age), and year and month of slaughter with slaughter age, carcass weight, price, and value were quantified using a mixed linear model; herd was included as a random effect. The seasonal trends in cow price and value traits were inversely related to the number of cows slaughtered, whereas annual variation in external factors affected market conditions. Relative to BS cows, HF cows were younger at slaughter (73.1 vs. 80.7 mo), yielded slightly lighter carcasses (242 vs. 246 kg), and received a slightly lower price (1.69 vs. 1.73 €/kg) and total value (394 vs. 417 €/head). Dual-purpose breeds were older and heavier and received a much greater price and total value at slaughter (521, 516, and 549 €/head, respectively for Si, Re, and AG) than either dairy breed. Of the dual-purpose cows, Si carcasses were heavier (271 kg), whereas the carcasses of local breeds received a higher price (2.05 and 2.18 €/kg for Re and AG, respectively) and Alpine Grey cows were the oldest at slaughter (93.3 mo). The price per kilogram of cull cow carcasses was greatest for very young cows (i.e., <3 yr of age) and the differential in price and value between younger and older cows was greater in dual-purpose than in dairy breeds. Large differences in cull cow whole carcass value (carcass weight × unit price) among dairy breeds suggest that such a trait could be considered in the breeding objectives of the breeds.

Key words: cull cow, carcass price, carcass value, age at culling

INTRODUCTION

The sale of cull cows represents a revenue source for dairy farms. Beef originating from culled dairy cows accounts for approximately 13% of domestically produced beef in the United States (USDA, 2005). Similarly, cull cows can represent 10 to 15% of the revenues of dairy farms in most European countries (Cabaraux et al., 2005); meat originating from cull cows can represent most of the beef consumed in some countries (Liboriussen, 1980; Vestergaard et al., 2007).

Factors influencing the decision to cull dairy cows include reproductive failure, mastitis and udder problems, low milk production, and old age. Several studies (Beaudeau et al., 1993; Esslemont and Kossaibati, 1997; Bascom and Young, 1998) have documented reproductive failure as the primary reason for culling, accounting for approximately 23% of culling events (Allaire et al., 1976). Mastitis and udder problems were identified as the second most important reason for culling (Bascom and Young, 1998; Smith et al., 2000; Cesarini et al., 2003), accounting for approximately 16% of culling decisions.

Breed of cow has been reported to influence culling rate (Heikkilä et al., 2012) but has also been documented to influence carcass weight and the value of cull cows (De Boer, 1980; Wiemer et al., 1982) as well as meat quality characteristics of beef cows (Dransfield et al., 2003). Several studies have quantified the effect of plane of nutrition on slaughter and meat traits, particularly in beef cull cows. Vestergaard et al. (2007) and Schnell et al. (1997) both reported clear differences in carcass characteristics of cull cows fed different diets. Increasing the nutritional plane of cull cows through supplementation before slaughter improved carcass characteristics (Matulis et al., 1987; Brown and Johnson, 1991; Minchin et al., 2009), as well as conformation and carcass fat level (Apple, 1999) and tenderness of meat (Miller et al., 1987).

Received January 15, 2013.
Accepted October 13, 2013.
[1]Corresponding author: massimo.demarchi@unipd.it

Furthermore, several studies have documented an effect of age at slaughter on carcass traits of dairy and beef cull cows (van Arendonk et al., 1984; Seegers et al., 1998) and also on BCS and carcass conformation (Vestergaard et al., 2007). The majority of studies on culled dairy cows were, however, undertaken under intensive production conditions or on extensive pasture environments, and there remains a paucity of knowledge of such in mountainous dairy production systems.

The aim of this study was to investigate the association between cow breed and year and month of slaughtering with age at slaughter, carcass weight, price, and value in culled dairy and dual-purpose cows reared in Alpine conditions.

MATERIALS AND METHODS

Animal care and use committee approval was not obtained for the present study because all of the data originated from a preexisting database from the Breeders Federation of the Trento Province (Trento, Italy) and the Unipeg Cooperative of Pegognaga (Mantova, Italy).

Data

Slaughter records on 20,995 cull cows of 5 breeds [2 dairy: Holstein Friesian (**HF**) and Brown Swiss (**BS**) and 3 dual-purpose: Simmental (**Si**), Rendena (**Re**), and Alpine Grey (**AG**)] originating from 486 dairy herds, between the years 2003 and 2011, were provided by the Breeders Federation of Trento (Trento, Italy), located in northern Italy. Crossbred cows were not included in the analysis due to a paucity of data. The farming systems of the area were described in detail by Sturaro et al. (2009, 2013). Cull cows were collected from dairy farms each Wednesday by the Breeders Federation and transported to a commercial slaughterhouse (Unipeg, Pegognaga, Italy) on Thursday. Information available on each animal included herd, breed, birth date, slaughter date, carcass weight (kg), and carcass value (€). Age at slaughter (mo) and carcass price (€/kg) were computed.

After examination of the distribution of the data available, only purebred dairy and dual-purpose cows between 24 and 200 mo of age at slaughter, a carcass weight between 170 and 400 kg, and a carcass value between €200 and €1,200 were retained. Furthermore, only animals from herds that supplied at least 10 cull cows across the whole study period were retained. In total, 6,931 records were discarded during the editing process; 8,927 HF, 9,555 BS, 1,117 Si, 917 Re, and 479 AG cull cows remained after editing. In 25.5% of the herds only 1 breed of cow was represented, whereas in 39.3% and 28.0% of the herds, 2 and 3 breeds were represented, respectively.

Statistical Analysis

Factors associated with age at slaughter (mo), carcass weight (kg), carcass price (€/kg), and carcass value (€) of cull cows were quantified using REML in a linear mixed model framework in PROC MIXED (SAS Institute, 2008). The significance of fixed effects in the model was based on the F-statistic and the significance of the random effects in accounting for the variation in the dependent variable was determined using the Akaike's information criterion (**AIC**; Akaike, 1969; Agresti, 2002) between models. The lower the AIC, the more parsimonious the model. The AIC includes a penalty for over-parameterization, to obtain a balance between fit and number of parameters to be estimated, and was calculated as follows:

$$\mathrm{AIC} = -2 \times \mathrm{logL} - 2 \times (\mathrm{k} + \mathrm{s}),$$

where k represents the number of response levels minus 1, and s is the number of predictive effects.

In all models, the random terms of herd and residuals were assumed to be independently and normally distributed with a mean of zero and variance of σ^2_H and σ^2_e, respectively. The general model fitted (based on biological plausibility) was:

$$\begin{aligned} y_{ijklm} = \mu + H_i + B_j + YS_k + MS_l + A_m + bCW \\ + (B \times A)_{jm} + (B \times YS)_{jk} + (B \times MS)_{jl} \\ + (YS \times MS)_{kl} + e_{ijklmn}, \end{aligned}$$

where y_{ijklm} is the observed trait; μ is the overall intercept of the model; H_i is the random effect of the ith herd (i = 1, …, 486); B_j is the fixed effect of the jth breed (j = HF, BS, Si, Re, AG); YS_k is the fixed effect of the kth year of slaughter (k = 2003, …, 2011); MS_l is the fixed effect of the lth month of slaughter (l = 1, …, 12); A_m is the fixed effect of the mth class of age of cull cow (m = 1 = <3 yr of age; 2 = between 3 and 4 yr; 4 = between 4 and 5 yr; 5 = between 5 and 6 yr; 6 = between 6 and 7 yr; 7 = >7 yr); CW is the linear covariate of carcass weight; $(B \times A)_{jm}$ is the interaction effect between breed and age of cows at slaughter; $(B \times YS)_{jk}$ is the interaction effect between breed and the year of slaughter; $(B \times MS)_{jl}$ is the interaction effect between breed and month of slaughter; $(YS \times MS)_{kl}$ is the interaction between the year and month of slaughter; and e_{ijklmn} is a random residual.

This model was used to analyze carcass price data (€/kg). Carcass weight (kg) and carcass value (€/head)