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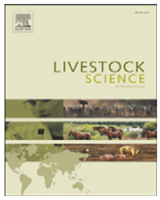

Mortality in Austrian dual purpose Fleckvieh calves and heifers

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A B S T R A C T

Most countries worldwide already include functional traits in the breeding goals for cattle. Among those are e.g. reproductive traits or longevity while traits regarding calves or heifers are hardly considered. Mortality, but also culling of heifers before first calving may result in higher replacement costs but also in reduced possibility for selection and is thus of importance in cattle breeding. Thus, the aim of this investigation was to explore the genetic background of postnatal mortality and involuntary culling in Austrian Fleckvieh (dual purpose Simmental) calves and replacement heifers. The following periods were defined for analyses: P1 = 48 h to 30 days, P2 = 31 to 180 days, P3 = 181 to 365 days, P4 = 366 days to first calving or a maximum age of 1200 days if no calving was reported, P5 = birth to age at first calving or a maximum age of 1200 days if no calving was reported, P4S = heifers having at least one insemination slaughtered in P4, defined as involuntarily culled. After data editing records of more than 86,000 calves and heifers were investigated. Mortality rates were 1.85, 1.39, 0.36, 0.70, and 5.61% for the defined periods P1–P5, respectively; 7.78% of heifers were involuntarily culled (P4S). For the estimation of genetic parameters a linear and threshold sire model and a linear animal model with the random effects herd*year and sire as well as the fixed effects year*month, number of dam's parity, and calving ease were applied. In total, the pedigree consisted of 11,609 animals (sire model, sire–dam relationship) and 237,113 animals (animal model). For mortality traits, heritabilities ranged from <0.0001 (P3) to 0.018 (P5) for the linear models, and 0.001 (P3) to 0.072 (P1) for the threshold model, respectively. Heritabilities for involuntary culling (P4S) were 0.024, 0.021 and 0.067 for the linear animal, linear sire and threshold sire model, respectively. The rank correlations were >0.99 between random effects of sires obtained with linear sire and threshold sire models and were lower ($r = 0.77$ to 0.90) for animal and sire models, respectively. Total calf and heifer mortality is higher than stillbirth. Consequently, its economic impact on cattle breeding should not be neglected. Based on the results obtained in this study selection against higher postnatal mortality and involuntary culling of heifers should be possible. Furthermore, monitoring of the population and of extreme bulls might be very useful for breeding organisations to avoid deterioration in these traits.

1. Introduction

Modern economically derived breeding objectives usually include fitness related or functional traits such as fertility and survival. While economic values of production traits may fluctuate with prices and costs, efficient reproduction and high survival are likely to be valuable under all future markets (Goddard, 2009). However, low heritabilities of such traits, their mostly unfavorable genetic correlations to performance traits (e.g. Philipsson and Lindhé, 2003), as well as insufficient or complete lack of recording and non-normal distributions complicate breeding or even lead to lack of consideration in selection. Nevertheless, realizing the economic and socioeconomic benefits of fitness traits, more and more countries have started to include such traits in the breeding goals for cattle in

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recent years (Miglior et al, 2005). Among the traits frequently being recorded and evaluated are traits expressed in the milking cow, such as reproductive traits, conformation traits, somatic cell score and longevity (www.interbull.org) while traits expressed in calves or heifers are hardly considered. Aside from reproductive traits in heifers and calving ease, only survival data of the calves' life first 24 or 48 h have been taken into account in breeding programs. This time span reflects the trait stillbirth which is usually defined as being born dead or having died within 24 to 48 h after birth (e.g. Fürst and Fürst-Waltl, 2006). Even if information about survival is available there is little knowledge with respect to survival of young breeding stock in the period from 24 or 48 hours to the start of productive life. Gulliksen et al. (2009) reported a mortality rate of 3.7% in the first year of life in Norwegian dairy herds, while Svensson et al. (2006) observed 3.1% of calves dying up to an age of 90 days in southwestern Swedish farms. In Denmark, 6.6% of Holstein calves (Hansen et al., 2003) and a rather alarming proportion of 12.5% of Jersey calves (Norberg, 2008) died up to an age of 180 days.

Dystocia, respiratory diseases or pneumonia and diarrhoea are frequently mentioned as the most important factors influencing mortality in calves and heifers (e.g. Svensson et al., 2006; Lombard et al., 2007; Gulliksen et al., 2009). Other factors affecting calf and heifer mortality include region, herd and group size, birth type, average herd milk production level, availability of colostrums, season of birth, sex of calf and dams' parity (e.g. Losinger and Heinrichs, 1997; Svensson et al., 2006; Gulliksen et al., 2009). Among the few genetic studies Hansen et al. (2003) analyzed genetic parameters of postnatal mortality of Danish Holstein calves aged up to 180 days using linear models. Direct heritability for postnatal mortality was very low ranging from 0.001 (day 15 to 60) to 0.008 (day 61 to 180). Slightly higher heritabilities were observed in Danish Jersey, ranging from 0.002 to 0.03 up to an age of 180 days (Norberg, 2008). An earlier study in a small data set of Brown Swiss cattle in Switzerland (Erf et al., 1990) reported a heritability of 0.04 for postnatal mortality within the first week of life. Another study dealing with mortality of beef calves from birth to weaning (Cundiff et al., 1986) estimated within breed heritability of 0.07. To our knowledge, no publications are available on heritabilities for heifer survival except our own recent work in Danish Holstein (Fuerst-Waltl and Sorensen, 2009) where linear and threshold heritabilities of 0.04 and 0.08, respectively, were reported for losses until first calving.

Although calf and heifer mortality is reported to be relatively low, they do raise ethical issues and their economic impact on cattle breeding is not negligible. Higher female calf or heifer mortality results in higher replacement and veterinarian costs and in reduced possibility for selection and genetic gain. Losses at higher ages up to first calving are even more economically important than early losses as replacement costs increase with age. In a Norwegian study, deaths among calves and replacement stock were estimated to cause annual losses of more than 15 million US$ (Østerås et al., 2007). Knowledge and analysis of the genetics of juvenile survival are important for better understanding of their biology, for monitoring cattle populations and deciding whether and how to include these traits in breeding programs (Shook, 1998).

The aim of this study therefore is to explore the genetics of calf and heifer mortality in Austrian Fleckvieh (dual purpose Simmental) by (1) defining relevant periods for juvenile survival, as evidence from earlier studies (Hansen et al., 2003) suggests that survival of calves and heifers is different at different stages of their life and may therefore be controlled by different genes; (2) comparing different methods (linear and threshold models, sire and animal model) for estimating variance components and genetic parameters; and (3) implementing a genetic evaluation of the current Austrian Fleckvieh population.

2. Material and methods

2.1. Animals

Records of Austrian Fleckvieh (dual purpose Simmental) calves and heifers born between January 1st, 2001 and February 10th, 2008 were provided by ZuchtData EDV-Dienstleistungen GmbH, the organization responsible for maintaining the nationwide cattle performance data base. Information about survival of calves is generally available due to the obligatory cattle registration in the EU (Regulation (EC) No. 1760/2000). To ensure reasonable data quality, data were restricted to singleton females having a theoretical chance of reaching the maximum age at first calving of 1200 days. Males were not considered, as many farms sell males for fattening at an early age. For further data validation a maximum foreign gene proportion of 12.5% Red Holstein, as well as full records regarding calving ease, herd and parentage were required. Furthermore, records of dams with a length of pregnancy lower than 270 and higher than 306 days, and an age at first calving lower than 550 days were excluded in accordance with the routine breeding value estimation procedures.

2.2. Definition of traits

Evidence from an earlier study (Hansen et al., 2003) suggests that survival of calves and heifers at different stages of their life may be controlled by different genes. Consequently, for analysing survival data of juvenile cattle, the following periods were defined: P1, 48 h–30 days; P2, 31–180 days; P3, 181–365 days; P4, 366 days-age at first calving (a maximum of 1200 days; and P5, from birth to first calving or a maximum of 1200 days. P1 and P2 correspond to neonatal and calf mortality as defined by Wathes et al. (2008). However, as stillbirth in the Austrian Fleckvieh data base is defined as born dead or died within the first 48 h (Fürst and Fürst-Waltl, 2006), P1 starts at 48 rather than 24 h. P5 corresponds to the full period between birth and first calving (=P1+P2+P3+P4). Records of calves and heifers that were slaughtered or exported within a period were set to missing for the period in question or subsequent periods while their records were kept for preceding periods.

Culling of heifers before first calving will also result in higher replacement costs and reduced possibility for selection and is therefore of importance in cattle breeding. Due to the dual purpose status of the Fleckvieh breed, some female animals might be deliberately fattened and sold as slaughter animals. However, if farmers had an animal