PRELIMINARY ANALYSIS OF FUNCTIONAL LONGEVITY IN THE AVILEÑA NEGRA IBERICA BEEF CATTLE BREED

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INTRODUCTION
Avileña Negra Ibérica is a Spanish beef cattle breed reared under very extensive conditions. In a situation of surplus of beef in the UE, traits related to diminishing costs of productions become more important. Economic studies in beef cattle populations have proved that length of productive life of cows is in straight relationship with the profit of farms (Phocas et al., 1998). This is so, if enlargement of length of life reduces costs of replacement and minimizes maintenance of non-productive females. Thus, for breeders a trait of interest is functional longevity, which is understood as the ability of the animal to stay productive in the herd. In addition, a part of the Avileña NI population is mainly oriented to produce females to be sold for commercial systems. For these types of breeders to include functional longevity, as a part of their selection goal is potentially useful.

The aim of this work was to identify environmental factors influencing longevity of Avileña NI cows as well as to estimate genetic components associated to this trait through the use of survival techniques.

MATERIAL AND METHODS
Data. Data were obtained from the Avileña NI recording scheme. Longevity (LFL) of cows was expressed as the time between the first and the last calving of a cow. The date of last calving was used as a reference time because date of culling was not totally reliable. A cow was considered to have a complete observation when either had a disposal code or its last calving happened three years before the last calving registered in the herd. Otherwise the record was considered as censored.

File consisted of 32,507 entries containing data of 6,524 cows in 99 herds. All cows had to have at least one of their calves weighted at weaning. Since level of production was thought as a cause of culling, cows had to have at least one of their calves weighted at weaning. Calvings occurred from 1979 to 2001. For this dataset pedigree file contained 10,875 animals with 512 sires, 4,138 dams and 458 maternal grandsires of cows with records. There were 2093 cows with their own records and with daughters with records as well. This dataset is referred to as DATA1. Another data set was obtained after removing records from herds where all records were censored (DATA2). Thus, file contained 31,297 entries from 6,053 cows in 61 herds. For this data set, pedigree file contained 10,149 animals with 467 sires, 3,825 dams and 428 maternal grandsires of cows with records. There were 1955 cows with their own records and with daughters with records as well.
Statistical analyses. The Cox model was first used to identify environmental factors influencing LFL in Avileña NI beef cattle breed for both datasets. Those environmental factors were later used to fit a Weibull frailty animal model. The Survival Kit (Ducrocq and Solkner, 1998) was used to analyze the data. For the analysis under a Cox model, the hazard function was defined as:

\[ h(t) = h_0(t) \exp\{ \sum (HYi(t) + AFCi(t) + WWDk(t) + MSl(t)) \} \]

where, \( h(t) \) is the hazard function of a cow at \( t \) days after her first calving, \( h_0(t) \) is the baseline hazard related to the ageing process, \( HYi \) the \( i \)th class of the effect of the herd-year of calving, changing at date \( \tau \), which is the first day of each year; \( AFCi \) is the \( j \)th class of the age at first calving effect. Age at first calving was classified in 10 classes including an unknown class; \( WWDk(t) \), and \( MSl(t) \) are the corresponding classes of the effect of weaning weight of calves, and morphology scores of cows as percentage deviation with respect to the herd mean in the year of calving, respectively, changing at the day \( t \) of each calving. For WWD, 10 classes were obtained (from −30% to +30% deviations). For MS, also ten classes were done varying from −4% to +4% deviations. Thus, HY, WWS and MS explanatory variables were considered as time dependent variables. For the Cox analysis, likelihood ratio tests were obtained for both datasets.

To estimate genetic components of LFL a Weibull frailty animal model was assumed including the previous environmental explanatory variables in addition to the additive genetic animal effect. For this analysis Herd-Year effect was treated at random. The heritabilities of LFL for both dataset were calculated on the log scale (Ducrocq and Casella, 1996 and Korsgaard et al., 1999) and on the original scale (Vollema et al., 2000).

RESULTS AND DISCUSSION

In DATA1 and 2, the proportion of censored records was 72% and 69%, respectively. A total of 1823 cows had uncensored records with an average LFL of 2373 days. Maximum longevity was 6373 days.

The Cox estimated survival function showed that hazard decreased with time. Estimated survivor function is shown in Figure 1a. This function represents the probability that cows stay alive at a given time. The risk of being culled seemed to be very important in the beginning of the production life. This is so, because of the definition of the trait. For cows with only one calving, longevity was arbitrarily set to 30 days because date of culling was unknown. Otherwise, the risk decreases in a monotonous way. A similar pattern has been also described for other populations specially in dairy cattle (Vukasinovic, 1999).

Likelihood ratio text indicated that all explanatory variables included in the model had a significant effect on the hazard of being culled of a cow, for both data sets. Maddala R² was 0.35. The estimate of class effects are provided as relative risk ratios (RR). The RR for AFC, WWD and MS are presented in Figure 1b, 1c and 1d, respectively. The reported RR were
obtained from the Weibull animal model. Only solutions for DATA2 are shown.

Figure 1. Estimator of survivor function (a) Effect of Age at first calving (b) Effect of level of production (c) Effect of morphology scores deviation of cows (d)

In the Figure 1b, it can be observed the risk of being culled of cows according to their age at first calving. Ignoring class 0 which is an unknown age class, the risk of culling seems to be lowered between 26 and 28 months of age (class 3) and started increasing again if first calving occurs after 38 months of age. Figure 1c shows the effect of level of production of cows. In general terms, low level of production is a cause for culling cows. Cows producing above 20% more than average seem to have the lowest risk of being removed from the herd. An effect of the lack of data in that class may be seen in the last class. The last classes would be formed by the most productive cows. However, these cows have almost 60% more risk of being culled than cows in the previous classes. Morphology scores of cows proved to be a consistent criterion used by breeders for culling decisions (Figure 1d). As the score of cows increases the risk of being disposed from the herd clearly decreases.

Estimates of the gamma parameters from the HY distribution (Table 1) were much lower than the one obtained by Cunningham et al. (1999) in a Simmental population. The low value of the gamma translated into a large value of variance among herd-year classes. Estimate of variance among herd-year combinations was larger than estimate of additive genetic variance among animals. This effect may be due to the existence of a large heterogeneity among herds or a lack of connectedness among herd-years classes.

AI is not widely used for animals involved in the selection scheme. Therefore, herd-year effect may be capturing an additional genetic variance among animals from different herd-year.
estimates of heritabilities in the log scale appeared to be lower than estimates found in the literature for dairy cattle (see; Vollem a, 1998) and beef cattle (Hyde, 2000). However, heritabilities in the original scale seemed to be in the range of others published for dairy cattle (Vollem et al., 2000). Censoring proportions had an effect on the estimate of heritability. Differences between estimates are due to the values of the Weibull and gamma parameter given that estimates of animal genetic variances remains constant for both cases.

Table 1. Estimates of Weibull parameters (ρ and intercept), parameters associated to the herd-year variance (γ), herd-year variance (Vhy) and animal effects (Va) and heritabilities in the log (h²-log) and original scale (h²-ori)

<table>
<thead>
<tr>
<th></th>
<th>ρ</th>
<th>Intercept</th>
<th>γ</th>
<th>Vhy</th>
<th>Va</th>
<th>h²-log</th>
<th>h²-ori</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data1</td>
<td>1.12</td>
<td>-9.01</td>
<td>0.453</td>
<td>5.839</td>
<td>0.009</td>
<td>0.0011</td>
<td>0.041</td>
</tr>
<tr>
<td>Data2</td>
<td>2.28</td>
<td>-8.83</td>
<td>0.539</td>
<td>4.337</td>
<td>0.009</td>
<td>0.0014</td>
<td>0.032</td>
</tr>
</tbody>
</table>

CONCLUSION
The environmental factors proposed in this study showed a significant influence on the hazard of a cow to be culled. Breeders seem to use level of production and morphology scores as criteria to take replacement decissions. Estimates of genetic parameters require to be further investigated through a simulation approach. Adequacy of Weibull model to LFL data has also to be checked. Other traits related to functionality of cows needs to be studied for the Avileña Negra Ibérica beef population.

REFERENCES