Estimation the Genetic Parameters for Calving Score using an Animal Model, in Aberdeen Angus Breed

Rodica Stefania Pelmus[1]*, Horia Grosu[2], Mircea Catalin Rotar[1]*, Mihail Alexandru Gras[1], Cristina Van[1]

[1]*National Research-Development Institute for Animal Biology and Nutrition, 1, Calea Bucuresti, 077015, Balotesti, Romania*
[2]*University of Agronomic Sciences and Veterinary Medicine of Bucharest, Faculty of Animal Productions Engineering and Management*

Abstract
The objective of this study was to estimate the breeding value and heritability for calving score using an animal model for population from Aberdeen Angus breed. Data consisted of records of 1297 calves of Aberdeen Angus breed from Aberdeen Angus Association Romania. The mean for calving score was 1.007±0.002. The breeding values for calving score for calves were between -0.013 and 0.075. The heritability for calving score was low 0.08 in Aberdeen Angus breed. The animal model was adequate due it is simpler than threshold model for calculate the genetic parameters for calving score.

Keywords: animal model, breeding value, cows, calving score

1. Introduction

Calving ease is an economic reproduction trait in Aberdeen Angus cattle. Aberdeen Angus is a breed from Scotland used for beef production. This breed has a superior meat quality. Aberdeen Angus is a breed which was adapted to environmental conditions from Romania. The Aberdeen Angus breed has the characteristics like resistance, precocity, growth rate and carcass quality [1]. The longevity and reproductive traits are key factors in beef herd [2]. The reproduction traits have a great importance in determining the economic efficiency of beef cattle production systems [3].

In the breeding program of Aberdeen Angus breed from Aberdeen Angus Association Romania are monitored the traits as reproductive precocity and development of reproductive parameters such as fecundity, fertility, vitality and viability. The calving ease breeding value is calculated from the main source of information calving score. The calving ease is an important economic trait [4]. The calving difficulty influences the costs by veterinary costs, the reproductive efficiency decreases by the calf losses. For genetic evaluation of cattle for calving ease the linear models are more suitable for the use of field data [5].

The aim of this study was to estimate the breeding values and heritability for calving score in Aberdeen Angus breed using an animal model.

2. Materials and methods

The data from 1297 Aberdeen Angus calves born in the years 2021 and 2022 were used in this study. The pedigree covered 2905 animals: 1297 calves, 314 bulls and 1294 dams from Aberdeen Angus Association Romania. In our study were two categories of calving: 1-is unassisted calving,

* Corresponding author: Pelmus Rodica Stefania, Tel. 0727193366, pelmus_rodica_stefania@yahoo.com
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2 - is assistance required. The model used is animal model described as follows [6]:
The model be written as:

$$y_{ijk} = S_i + H_j + a_k + e_{ijk}$$

y_{ijk} = is an observed score (a number from 1 to m) on calf k, of sex i, in herd j
S_i =is a sex of calf effect
H_j= herd effect
a = is a calf additive genetic effect
e = is a residual error effect
The model included the fixed effects: the sex and the herd. The sex has two levels: female and male. The levels of effect herd were 292. The fraction of animals in the first category (0.992= 1287/1297 (from category one-unassisted calving) and in the second category 0.007= 10/1297.
From all calves, 813 calves were females and 484 were males.

3. Results and discussion

The calving ease is influenced by genetic factors and environmental factors. The genetic influence on calving ease presents direct component due the direct effects and a component due to maternal effects [4].
The statistics for calving score was presented in Table 1.

Table 1. Descriptive statistics for calving score

Mean	1.007
Standard Error	0.002
Median	1
Mode	1
Standard Deviation	0.087
Sample Variance	0.007
Kurtosis	125.194
Skewness	11.269
Range	1
Minimum	1
Maximum	2
Sum	1307
Count	1297
Confidence Level (95.0%)	0.004

Data from Table 1 indicate a mean of 1.007 for calving ease and a standard error 0.002. The calving ease measures the ability of a cow to calve easily. Calving ease is a part of the performance recording in beef cattle in many countries. The scoring systems are used to describe calving ease or calving difficulty depending on the country. The calves born easy are healthy that the calves born with difficulty which are less healthy because they consume loss colostrum. The factors that influence the dystocia are: age of dam, calf birth weight, dam's pelvic area, sex of calf, size of the dam, gestation length, breed and genotype of sire, breed and genotype of dam, condition of dam, nutrition of the dam, shape of the calf, position or presentation in the uterus, geographic condition [7]. The incidence of dystocia is different across breeds and countries [5]. The heifers have the majority of calving difficulty and associated calf loses. The small to moderate sized heifers must be mated to bulls of moderate sized breeds to reduce the dystocia. Inadequate nutrition of the young developing heifer can affect her subsequent calving performed [8]. Calving ease is a trait more influenced by management practice and less heritable. A mean of 1.43 for calving ease in Aberdeen Angus from Bulgaria observed and that the calving ease was influenced by the order of lactation, the father, the origin of father and the origin of cows [9]. The calving ease is influenced by the season of calving [10]. The reproductive capacity of the cows is influenced by the balanced feeding, physiological status of animals [11, 12]. The sex of calf influenced the calving ease. In our study from 10 calves calving with assistance, were six males and the four females. The males have a higher birth weight.

Table 2. Descriptive statistics for birth weight

Mean	29.55
Standard Error	0.136
Median	29
Mode	30
Standard Deviation	4.908
Sample Variance	24.089
Kurtosis	2.024
Skewness	0.949
Range	31
Minimum	19
Maximum	50
Sum	38334
Count	1297
Confidence Level (95.0%)	0.267

Data from Table 2 indicate a mean of 29.55 and a standard error 0.136 for birth weight. The birth weight influences the calving ease. The heavy calves have an increased incidence of calving difficulties.

In beef breeds double muscling or muscular hypertrophy is associated with various reproductive issues [13]. Two copies of the mutated myostatin gene were unfavorable for calving ease in Piedmontese cross animals [14]. Piedmontese and Gelbvieh sired calves had a higher calving difficulty score than the Red Angus sired calves, though the score was between 1 (no difficulty) and 2 (minor difficulty with some assistance [15]. A high incidence of calving difficulty is in some of the double muscled beef breeds, or double muscled blood lines within breeds that have this trait [7].

The relationship between external pelvic measurements and calving ease was studied by other authors [16]. External pelvimetry might be of practical use in preventing dystocia and perinatal mortality in suckler cows.

In table 3 gives the breeding value for the best 10 calves for calving score. Negative values are better than positive values because the categories were numbered from easiest to calving with assistance. The calves with low breeding value are the best because the calves had score 1 at calving. The breeding value for calving ease is important to select the best animals for this trait. The calving ease daughters is the ability of a sire's daughters to calve at two years of age without assistance. The gestation length influences the calving ease. Longer gestation length determines larger calves that can determine calving difficulties. Table 4 show the heritability for calving score. The heritability in our study is low. The Aberdeen Angus breed had lower frequencies of calving with assistance. The heritability for calving ease is different in beef breeds. The heritability for calving ease from our study (0.08) was between the value obtained in the literature. The direct heritability was obtained for calving ease in two independent samples of herds, 0.21 in sample of 19 herds and 0.07 in sample of 34 herds and the maternal heritability 0.27 in sample of 19 herds and 0.20 in sample of 34 herds in Aberdeen Angus breed [17]. The direct heritability of 0.29 and maternal heritability 0.13 were reported in multibreed beef population [18]. The direct heritability of 0.35 and maternal heritability of 0.18 were reported in Gelbvieh breed [19]. The direct heritability of 0.10 and maternal heritability 0.04 using linear model and 0.06, 0.010 using threshold model were reported in dairy cattle [20]. The values of heritability in different breeds were 0.07 for Simmental, 0.37 for Polled Hereford and 0.47 for Gelbvieh [4].

The effect of sire, breed of sire, the effect of breed of dam, the effect of sire of dam influences the calving ease [21]. The cows from Aberdeen Angus breed had easy calving and healthy calves. The Angus mothering instinct is very strong, the cows have superior milking ability. The Angus cows have good maternal traits, calving ease and ability to milk producing a calf each year. The Aberdeen Angus presents early maturity, fertility and stability.

The farmers can manage calving ease like selecting appropriate sires, assuring the nutrition and condition of pregnant cows and preparing to assist difficult birth if it is necessary.

The prediction of sire values for calving ease scores of future calves was calculated by best linear unbiased prediction procedures and constated that Shorthorn, Hereford and Angus sires caused relatively few calving difficulties while Maine-Anjou sires caused more difficulties [22].

In the genetic evaluation for calving difficulty in beef cattle used different models: univariate threshold animal, threshold sire-maternal grandsire, linear animal and linear sire- maternal grandsire models and bivariate threshold-linear animal, threshold-linear sire-maternal grand sire, linear-linear animal and linear-linear sire-maternal grandsire models and concluded that the threshold-linear animal models seem to the best choice for predicting both direct and maternal effects [23]. When analyzing data with small herds, in order to obtain an unbiased evaluation under a nonrandom and negative association of sire and herd effects, the best model for a practical evaluation was the fixed linear model [24]. The calving ease is a desired and necessary trait. Calving difficulty can determine lower calf survivability and extend post-partum intervals for cows. In American Angus Association, the calving ease is important for decide which bulls to mate to first calf heifers. Expressed as a probability percentage, calving ease aims to predict the percentage of unassisted birth a bull will produce when mated to heifers. The calving ease is a trait

important for farmers because reduce the cost of assisting cows during calving and the cost of lost calves [25]. Using threshold models increase complexity and computing time in contrast to linear models [26].

Table 3. The breeding value of the 10 best Aberdeen Angus calves for calving score

No.	Breeding values for the best calves
1	-0.013
2	-0.013
3	-0.013
4	-0.013
5	-0.012
6	-0.012
7	-0.010
8	-0.008
9	-0.007
10	-0.006

Table 4. The heritability of Aberdeen Angus population for calving score

Trait	h^2
Calving score	0.08

4. Conclusions

The heritability of calving score was low in Aberdeen Angus breed. The animal model was easy to use to estimate genetic parameters for calving score. In the selection of cows, the breeding value is important for choice the best animals. The genetic parameters are important in the breeding program of the Aberdeen Angus breed.

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