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Short Communication

Genetic parameters for first calving interval in beef cattle

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The aim of this study was to estimate genetic parameters for first calving interval in beef cattle population of the Czech Republic. Database of performance testing of 64 thousand of cows with repeated records was used to analyse. There were significant effects ($P < 0.001$) of age at first calving, herd-year-season, breed, calving difficulty and heterosis of cow ($P = 0.038$). Genetic parameters were estimated by AIREML. Heritability of first calving interval (0.1) was estimated.

Keywords: calving interval, reproductive traits, beef cattle, heritability

1 Introduction

Beef cattle fertility is one of the most economically important traits affecting profitability of beef production. Nowadays farmer focused on improving beef cattle fertility traits and fertility should be included into breeding goal. Additionally, limited information on female fertility is available from pasture system of breeding. Calving interval (CI), the number of days between successive calvings, is an indicator of female fertility (Gutiérrez et al., 2002). The target level is 365 days. A shorter calving interval can be associated with cows whose first calves were born late, and selection of these animals may result in an indirect selection for a later age at puberty (Cammack et al., 2009). Cows that give birth to calves in an interval of less than 365 days will have an earlier date of calving each year until they approach a limit set by the initiation of the breeding season (Werth et al., 1996). Conversely, if cow give birth to calves in an interval of more than 365 days it consequently can lead to disruption of breeding season too. The implication is that cows with the shortest calving interval are the most fertile and reproductively the most efficient and consequently they are selected in preference to cows with longer calving intervals (MacGregor, 1999). Situation where cows that calve the earliest during the calving season have the longest subsequent calving intervals, whilst those caving that are late in calving season should be taken into account during evaluation of calving interval. Lower heritability is partly affected by the existence of a very important influence on reproductive traits (Solemani-Baghshah et al., 2014) but the low heritability of fertility traits generally has largely discouraged efforts to improve them (Makgahlela, et al. 2008). The aim of this study was to estimate genetic parameters for first calving interval in Czech beef cattle population.

2 Material and methods

2.1 Data

Data of performance testing of 64 thousand of cows with repeated records of twelve beef breeds and crosses between 1995 and 2014 were used for analyse. This database is used for routine genetic evaluation of growth traits of beef cattle in the Czech Republic.

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2.2 Definition of trait

Only the first CI was analysed. CI was calculated as the number of days between second calving date and the first calving date. CI shorter than 290 and longer than 630 were removed according Gutiérrez et al. (2002), Roughsedge et al. (2005), Veselá et al. (2013).

2.3 Statistical methods

Data were edit to ensure an appropriate data structure for the parameter estimation. These edits inspired by Veselá et al. (2013) were applied. In HYS of birth and also in HYS of calving, then minimum size of HYS was at least 5 cows, each cow had to have at least 4 half-sisters. After these edits the data set contained 19 450 cows with calving interval.

The significant environmental fixed effects were determined using GLM procedure in SAS analytical software. The genetic parameters were estimated by residual maximum likehood using AIREMLF90 program. The following model equation was used for the first CI:

$$y_{ijklmn} = \mu + Afc_i + Afc_j^2 + HYSfc_k + Het_l + CD_m + Anim_n + e_{ijklmno},$$

where:

$y_{ijklmn'}$ = value of first calving interval in days; μ is general mean;
afc_i = linear regression of age at first calving in days;
Afc_j^2 = quadratic regression of age at first calving;
HYS_k = random effect of k^{th} herd-year-season of first calvings (k = 1, ... 2683);
het_l = linear regression on heterozygosis of dam;
CD_m = calving difficulty of second calving (m = 1, ... , 4);
$anim_n$ = random animal additive genetic effect of the n^{th} animal (m = 1,…62994, four generations are included);
$e_{ijklmno}$ = random residual error

3 Results and discussion

Descriptive statistics of the data used in genetic parameters estimation are shown in Table 1. The genetic parameters estimates for first calving interval are shown in Table 2. There was a significant effect of age at first calving, herd-year season, breed, calving difficulty ($P < 0.001$) and heterozygosis of dam ($P = 0.038$). The greatest influence on calving interval had HYS of first calving. In HYS, many effects are included like year of calving, calving season, herd health and nutrition or herd management. The herd management included the influence of breeder who controls it. If the cows are to maintain an annual calving interval they should be able to conceive within 80 to 85 days after calving. It is stressful you young cows because of nutrient deficiency, calving difficulty and health problems. Moreover young cow must satisfy their own growth, maintenance and lactation requirements. Young beef cows have longer periods of postpartum anestrus than the mature cows and their calving interval is often longer than 365 days (Werth et al. 1996). Heritability estimates for first CI was low (0.1). Heritability of 0.09 to 0.13 have been reported by Roughsedge et al. (2005) for most of breed, expect Limousine (0.04). Some authors had estimated higher heritability, Guttieréz et al. (2002) 0.13, Veselá et al. (2013) 0.39. Variance in estimated heritabilies can be caused by using different statistical models, differences in genetic variation among populations or breeds or varying reactions to different environmental conditions.

Table 1 Descriptive statistics of first calving interval

Trait	n	Mean	s.d.	x_{min}	x_{max}
First calving interval	19 450	384.74	52.64	290	630

Table 2: Variance components and genetic parameters for calving interval

Trait	σ^2_e	σ^2_a	σ^2_{HYS}	h^2	SD σ^2_a	SD σ^2_{HYS}	SD σ^2_e
First calving interval	1757	272	997	0.1	35.01	43.02	33.06

σ_e^2 = residual variance; σ_a^2 = additive genetic variance; σ_{HYS}^2= Herd-Year-Season variance; σ_P^2= phenotypic variance; h^2 = (σ_a^2/ σ_P^2) = heritability; SD σ^2_G = standard deviation of additive genetic variance; SD σ^2_{HYS} = standard deviation of Herd-Year-Season effect; SD σ^2_E = standard deviation of residual variance;

4 Conclusions

Estimated heritability of calving interval was low but improving of this trait is possible by identifying animals with high genetic merit for reproductive performance and improves fertility through selection.

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References

CAMMACK, K.M. et al. (2009) Review: Reproductive Traits and Their Heritabilities in Beef Cattle. *PAS*. vol. 25, pp. 517-528. Retrieved February 12, 2016 from http://www.professionalanimalscientist.org/article/S1080-7446(15)30753-1/pdf

GUTIERREZ, J.P. et al. (2002) Genetic relationship between calving date calving interval, age at first calving and type traits in beef cattle. *Livest. Prod. Sci.,* vol. 78, pp. 215-222. doi: http://dx.doi.org/10.1016/S0301-6226(02)00100-8

MAKGAHLELA, M.L. et al. (2008) Genetic Analyses of Age at First Calving and Calving Interval in South African Holstein Cattle. *Asian J. Anim. Vet. Adv.*, vol. 3, pp. 197-205.
doi: http://dx.doi.org/10.3923/ajava.2008.197.205

MaCGREGOR, R.G. et al. (1999) Evaluation of calving interval and calving date as measures of reproductive performace in beef breed. *Livest. Prod. Sci.,* vol. 57, pp. 181-191. doi: http://dx.doi.org/10.1016/S0301-6226(98)00158-4

ROUGHSEDGE, T. et al. (2005) Genetic parameters for maternal breeding goal in beef production. *J. Anim. Sci*., vol. 83, pp. 2319-2329. Retrieved February 12, 2016 from https://www.animalsciencepublications.org/publications/jas/pdfs/83/10/0832319

SOLEMANI-BAGHSHAH, S., et al. (2014) Estimation of Genetic and Phonotypic Trends for Age at First Calving, Calving Interval, Days Open and Number of Insemination to conception for Isfahan Holstein Cows. *Int. J. Adv. Biol. Biom. Res*., vol. 2, no. 5, pp. 1307-1314. Retrieved from http://www.ijabbr.com/article_7331_515d1b7a9df4ff4ae2b327ee9e365000.pdf

VESELÁ, Z., VOSTRÝ, L. and SVITÁKOVÁ, A. (2013) Genetic Analysis of Female Fertility Traits in Beef Cattle in the Czech Republic. *Interbull bulletin*, vol. 47, pp. 172-175. Retrieved February 12, 2016 from https://journal.interbull.org/index.php/ib/article/viewFile/1316/1386

WERTH, L.A. (1996) Calving Intervals in Beef Cows at 2, 3, and 4 Years of Age When Breeding Is Not Restricted After Calving. *J. Anim. Sci.,* vol. 74, no. 3, pp. 593-596.