Current System of Beef Evaluation in the Czech Republic

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Introduction

Beef cattle production in the Czech Republic is a relatively new industry that has expanded since 1990. In total, twelve beef cattle breeds and their crosses are kept in the Czech Republic. Breeders of beef cattle breeds are associated in Czech Beef Cattle Breeders Association (http://www.cschms.cz).

In table 1 there are numbers of calves born in herds with production recording in 2005. Considering the fact that the sire of calves is always purebred bull of certain beef breed, the results are divided after the dams of calves, respectively in accordance to their genotype.

In table 2 there are numbers of cows involved in the beef performance recording in 2005 according to their genotype (Czech Beef Cattle Breeders Association, 2007). The most popular beef breeds in the Czech Republic are Charolais cattle, Beef Simmentaler, Aberdeen Angus and Hereford.

Great progress has been made in the breeding of beef cattle in the Czech Republic in the last years. Since 2000 breeding value in beef cattle in the Czech Republic has been estimated for the results of a field test (calving ease, birth weight and weight at the age of 120, 210 and 365 days) by a multi-trait animal model (Přibyl et al., 2003). In 2004 the estimation of breeding value for the own growth of bulls at performance-testing stations by a single-trait animal model was introduced (Přibylová et al., 2004) and in 2005 for a description of the type traits of young animals of beef cattle by a multi-trait animal model (Veselá et al., 2005). In 2006 selection indexes for beef cattle in the Czech Republic were constructed on the basis of these evaluated traits (Šafus et al., 2006).

Field test

The evaluated traits are calving easy (ce), birth weight (birth), weight at the age of 120 days (120), 210 days (210) and at one year of age (365).

Breeding value is determined by multitrait animal model according to a model equation:

$$y_{ijkl} = \mu + h_i + s_j + am_k + a_{ijkl} + m_{ijkl} + p_{ijkl} + hd_{ijkl} + hm_{ijkl} + e_{ijkl}$$

where

y_{ijkl} - is a performance (ce, birth, 120, 210, 365)

μ - population mean

h_i - random effect of the group of jointly evaluated animals (herd, year, season)

s_j - fixed effect of the sex of the animal (bulls, heifers / twins, singles)

am_k - fixed effect of the age of mother at calving (younger than three years, four years old, five to seven years old, older than seven years)

a_{ijkl} - random additive genetic effect

m_{ijkl} - random maternal genetic effect; Direct effect and maternal effect are correlated with each other, with common matrix of relationship and genetic groups (28 groups according to breeds and genetic shares of crossing)

p_{ijkl} - random maternal pernament environment effect

hd_{ijkl} - heterosis of calves – regression according to calf heterozygosity

hm_{ijkl} - heterosis of dams – regression according to dam heterozygosity

e_{ijkl} - random residual

The population-genetic input parameters are in table 3 and 4. Direct and maternal effects of an individual and permanent maternal environment are used as random effects. As the number of offspring is low in some herds within HYS, this effect is also used as a random one.

Own growth of beef bulls at performance-test station

The bulls (candidates for breeding) are placed in performance-test stations after the end of grazing season approximately at the age of 7 to 10 months. The long of the test is 120 days. The estimation of breeding value according to own growth ability in the performance-test stations is difficult because the bulls come from different farm conditions and at a different phase of a growth curve. Further it is complicated due to the fact that the animals are selected and there come only small numbers of individuals from particular herds and of the same parents which interferes with kinship.

The data for processing are obtained from 9 performance-test stations and licensed stables. The database is recorded at the Czech Beef Cattle Breeders Association.

Breeding value is estimated by single-trait animal model according to a model equation:

$$y_{ijkl} = \mu + h_i + am_j + ch_k + aAT_{ijkl} + bAT_{ijkl}^2 + g_{ijkl} + e_{ijkl}$$

where

y_{ijkl} - evaluation of the trait
μ - population mean
h_i - fixed effect of the group of jointly evaluated animals (station, year, season)
am_j - fixed effect of the age of mother at calving (younger than three years, four years old, five to seven years old, older than seven years and embryo recipients)
ch_k - class of herd (The herds from which the individuals came, were divided into 5 classes according to average gain.)
$aAT_{ijkl} + bAT_{ijkl}^2$ - quadratic regression at the age of introduction into the test

g_{ijkl} - breeding value of the animal (random effect) – with the relationship matrix and genetic groups according to the breed
e_{ijkl} - random error

Components of variance and consequently coefficients of heritability were determined on the basis of animal model $h^2 = 0.27$ and with regard to the fact that frequency of individuals within families in performance-test stations is small also with SMGSire model $h^2 = 0.29$ and sire model $h^2 = 0.50$. In consequence of frequency of the offspring after sires we do not consider the data for sire model to be reliable. For determination of breeding value we recommend a compromised value $h^2 = 0.30$.

Type traits of young animals

Evaluation of the type is an integral part of cattle breeding. Objective evaluation of the type in beef cattle is significantly related with the expression of meat performance. An evaluation method is given in methodical instructions for the description and evaluation of the type of beef cattle by Czech Beef Cattle Breeders Association (Czech Beef Cattle Breeders Association, 1996).

Evaluation is based on the scoring of an evaluated trait by 1 (minimum) to 10 (maximum) points within the biological extremes of evaluated breed. Evaluating the scored traits, the classifier takes into account the population mean of evaluated breed and approved breed standard. Therefore the expression of the scoring scale for body traits according to the particular breeds is quite specific. The evaluation of the type involves 10 traits: height at sacrum – HS (measured with a measuring staff), body length – BL, live weight – LW (determined by the weighing of the animal), front chest width – CW (width of the chest base between the front legs front view), chest depth – CD (chest depth behind the blade), pelvis – P (pelvis length and width), shoulder muscling – SM, back muscling – BM, pelvis muscling – RM and production type – PT (overall thoroughbredness, harmony of body conformation and sex expression). A majority of traits is evaluated subjectively.

Height at sacrum and live weight are determined by measuring and weighing, and conversion tables are used to obtain their point scoring while age, sex and breed are respected. Breeding values and genetic parameters are estimated by a multi-trait animal model.

Traits are divided into two groups: 1. traits scoring body measurements and body capacity (height at sacrum, body length, live weight, front chest width, chest depth and pelvis) and 2. traits scoring muscling and overall type (shoulder muscling, back muscling, rump muscling and production type).

For the first group of traits this model equation is used:

$$y_{ijkl} = \mu + h_i + s_j + am_k + aAE_{ijkl} + g_{ijkl} + e_{ijkl}$$

For the second group of traits this model equation is used:

$$y_{ijk} = \mu + h_i + s_j + aAE_{ijk} + bDG_{ijk} + g_{ijk} + e_{ijk}$$

where

y_{ijkl} (y_{ijk})	- evaluation of the trait
μ	- population mean
h_i	- fixed effect of the group of jointly evaluated animals (herd, year, season)
s_j	- fixed effect of the sex of the animal (bulls, heifers / twins, singles)
am_k	- fixed effect of the age of mother at calving (younger than three years, four years old, five to seven years old, older than seven years and embryo recipients)
aAE_{ijkl} (aAE_{ijk})	- regression on age at evaluation (legendre polynomial)
bDG_{ijk}	- linear regression on average daily gain from birth to the date of evaluation
g_{ijkl} (g_{ijk})	- breeding value of the animal (random effect) – with the relationship matrix and genetic groups according to the breed
e_{ijkl} (e_{ijk})	- random error

Table 5 shows estimated standard deviations (σ_g, σ_e) that are substituted into the calculation of breeding values. The estimated standard deviations for height at sacrum (σ_g = 1.27, σ_e = 1.25) and live weight (σ_g = 1.58, σ_e = 1.60) are markedly higher; it is a result of different method of evaluation of these two traits. Coefficients of heritability h^2, phenotypic correlations r_p and genetic correlations r_g are given in table 6.

Selection indexes for bulls of beef cattle

Three selection indexes were constructed for bulls of beef cattle: IM for terminal crossing (in dairy herds), IZ for the selection of foundation sires for beef herd and IS for the selection of bulls for beef herd. Each index was constructed in five variants that differed in the number of used traits from the most important ones to all traits with known breeding values. The sources of information were breeding values routinely calculated in performance testing – 10 breeding values for direct and maternal effects for easy calving and growth, breeding value for daily gain of bulls at performance-testing stations and 10 breeding values for the type traits of young animals. The reliability of partial breeding values that enter into the indexes ranged from 11% to 36%. Reliability influences subsequent accuracy of index selection for total genotype that is in the range of 30% to 46%. The discounting of economic values (0% or 10%) did not influence the selection indexes significantly. Index selection was expressed almost exclusively in genetic gain of direct effects while maternal effects were of only small importance in the breeding objective. Direct effects for daily gain until weaning and after weaning are of the highest importance in the breeding objective, accounting for 90% to 96% of the total selection effect. The most important information sources in selection indexes are direct effect of weaning weight (importance of approximately 74% to 95%) and maternal effect of weaning weight (importance of approximately 5% to 7%). The inclusion of daily gain of bulls at performance-testing stations with the importance of about 16% in the index decreased the importance of

weaning weight. Selection can be aimed at these main traits – calving ease (direct and maternal effect) and weight at 210 days (direct and maternal effect) only because the importance of the other traits in the index is very low.

Future development

The most important task for future is genetic evaluation of female fertility traits (calving interval, age at first calving and calving date) and carcass traits.

Literature

Czech Beef Cattle Breeders Association. 2007. *Annual report of the Beef Performance Recording in 2005,* s. 96.

Czech Beef Cattle Breeders Association . 1996. Český svaz chovatelů masného skotu v Praze - Metodika popisu a hodnocení zevnějšku masných plemen skotu, (http://www.cschms.cz).

Přibyl, J., Misztal, I., Přibylová, J. & Šeba, K. 2003. Multiple-breed, multiple-traits evaluation of beef cattle in the Czech Republic. *Czech J. Anim. Sci. 48,* 519-532.

Přibylová, J., Vostrý, L., Veselá, Z., Přibyl, J. & Bohmanová, J. 2004. Breeding value for own growth of beef bulls in performance-test station. *Animal Science Papers and Reports, 22,* 97-103.

Šafus, P., Přibyl, J., Veselá, Z., Vostrý, L., Štípková, M. & Stádník, L. 2006. Selection indexes for bulls of beef cattle. *Czech J. Anim. Sci. 51,* 285-298.

Veselá, Z., Přibyl, J., Šafus, P., Vostrý, L., Šeba, K. & Štolc, L. 2005. Breeding value for type traits in beef cattle in the Czech republic. *Czech J. Anim. Sci. 50,* 385-393.