GENETIC PARAMETERS FOR SEX-SPECIFIC TRAITS IN BEEF CATTLE : MATURE WEIGHT OF COWS AND CARCASS TRAITS OF STEERS

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INTRODUCTION

Although major changes have occurred in size of farm animals since the beginning of scientific animal production, physical laws of nature dictate the limits within which various body dimensions or physiological functions of animals may vary (Brown *et al.,* 1983). Identification of an optimal size for all production situations is therefore not possible (Fitzhugh, 1978). However, animal breeders wonder if the size of the beef cattle may not be too large for the breeding herd because of the increase in maintenance costs associated with heavier mature cow weights (Urick *et al*., 1971). Although there are numerous estimates of genetic relationships for many pairs of economically important traits in beef cattle, there is a paucity of information on how mature weight of cows is related to carcass traits. Selection for traits measured in one sex of beef cattle may yield undesirable response in traits measured in the opposite sex (Speer, 1993). The objective of this study was to investigate the genetic relationships between mature weights of cows and carcass traits of steers.

MATERIALS AND METHODS

Description of data. Female mature weights (n=37710) and carcass measurements of their steer paternal half-sibs (n=4032) from the first four cycles of the Germplasm Evaluation (GPE) Program at the U. S. Meat Animal Research Center (USMARC) were used. For Cycles I through III (1970 to 1976), the right side of each carcass was processed at Kansas State University. For Cycle IV (1986-1990), processing was done at USMARC. Female mature weights of 1800 cows with corresponding body condition scores, with a maximum of 29 weights and a minimum of 5 weights per cow were available from four through eight years of age. Cows were weighed in four different seasons each year; at start of breeding season, at end of breeding season, at palpation for pregnancy following weaning, and prior to calving. Detailed information about the design of the experiment and the breeding plan is available in GPE Progress Reports (1974, 1980).

Statistical analysis. Co(variance) components of and among mature weight (MW), mature weight adjusted for body condition score (AMW) and carcass traits were estimated with a derivative-free REML algorithm using the MTDFREML programs (Boldman *et al.*, 1995).

The model for all carcass traits included fixed effects of breed group, year of birth and their interaction, and age of dam. Weaning age and slaughter age (in days) were included as linear covariates. Additive genetic and total effect due to the dam were random effects in the model. Because carcass data were processed at two different locations, data were standardized with the phenotypic standard deviation for each year to account for different scales of measurement.
Three sets of analyses were run for MW and AMW: (1) overall analyses including all data, (2) analyses by age of the cow (in years) and (3) analyses by season of measurement. The model included cow breed group, age in years, season of measurement and their interactions, year of birth, and the cow's physiological status (pregnancy-lactation code) as fixed effects for MW. Analyses of AMW included body condition score as a covariate for MW. Analyses by age in years included age in days within seasons as an additional linear covariate. Random effects included additive genetic and permanent environmental effects of the cow. Maternal genetic effects were found to be negligible and were excluded from the model.

Variance components and heritabilities for each trait were estimated with a single trait animal model. Genetic parameters for pairs of mature weight and carcass traits were obtained by fitting bivariate animal models. Because mature weight and carcass traits were measured on distinct subsets of animals standard errors for the genetic correlations were obtained by fitting an equivalent single trait animal model.

RESULTS AND DISCUSSION

Estimates of heritability for MW and AMW obtained using repeatability models were 0.52 and 0.57, respectively for overall data. Heritability estimates for MW and AMW from analyses by season of measurement and by age (in years) were consistent with overall estimates. These results are in close agreement with those reported by Northcutt and Wilson (1993). Estimates of heritability for hot carcass weight (HCWT), retail product percentage (RPP), fat percent (FAT), bone percent (BONE), rib eye area (REA), adjusted fat thickness (AFAT), estimated kidney, pelvic and heart percentage (EKPH), marbling score (MARB), Warner-Bratzler shear force (WBSF), taste panel flavor (TPF), taste panel juiciness (TPJ) and taste panel tenderness (TPT) measured on steers were 0.52, 0.59, 0.53, 0.52, 0.57, 0.46, 0.65, 0.46, 0.29, 0.05, 0.01 and 0.26, respectively. The results are similar to previous literature estimates (Koots *et al.*, 1994).

Estimates of genetic correlations and standard errors for overall analyses of MW and AMW with carcass traits are presented in Table 1. Genetic correlations between mature weight and carcass traits were similar whether mature weight was adjusted or unadjusted for body condition score. In general, estimates are low. Genetic correlations between mature weight of cows and carcass traits of steers were also estimated for mature weights analyzed separately by season of measurement and by age (in years). Those estimates were consistent with estimates in Table 1.

Table 1. Estimates of genetic correlations (± s.e.) from bivariate analyses of mature weight (MW) or adjusted mature weight (AMW) of cows with carcass traits of steers

Traits	MW (kg)	AMW (kg)
HCWT (kg)	0.81 ± 0.06	0.82 ± 0.05
RPP (%)	-0.05 ± 0.07	-0.02 ± 0.07
FAT (%)	-0.02 ± 0.08	-0.07 ± 0.07
BONE (%)	0.25 ± 0.08	0.34 ± 0.07
REA (cm^2)	0.34 ± 0.07	0.32 ± 0.07
AFAT (cm)	-0.03 ± 0.08	-0.10 ± 0.08
EKPH (%)	0.00 ± 0.07	-0.02 ± 0.07
MARB (score)	-0.15 ± 0.08	-0.16 ± 0.08
WBSF (kg)	0.15 ± 0.10	0.15 ± 0.09
TPF (score)	0.28 ± 0.31	0.14 ± 0.26
TPJ (score)	-0.29 ± 1.30	-0.38 ± 1.50
TPT (score)	-0.20 ± 0.12	-0.20 ± 0.12

CONCLUSION

Estimates of genetic correlations between mature weight and carcass composition or meat quality traits were relatively low. Selection for mature cow weight could be effective but would not be expected to result in much change in the carcass and meat traits such as percentage retail product, marbling and tenderness. Selection for most carcass and meat traits could be effective and would be expected to lead to only minor changes if any in mature weight. Estimates of genetic parameters for mature weight of cows were similar whether mature weight was adjusted or unadjusted for body condition score and were consistent across weights from all seasons and all ages.

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