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Genetic relationships of body condition score with carcass traits in Limousin cattle

Abstract

Field data from the North American Limousin Federation was used to determine the heritability and genetic correlations of body condition score (BCS) with carcass traits. Carcass traits included carcass weight, ribeye area, fat thickness, intramuscular fat, and % kidney, pelvic, and heart fat, and all were estimated to be lowly to moderately heritable (0.14 to 0.34). Heritability of BCS was 0.19. Favorable correlations existed between ribeye area and carcass weight (0.50), ribeye area and BCS (0.60), and carcass weight and BCS (0.28). Unfavorable correlations existed among ribeye area and intramuscular fat (-0.40), carcass weight and intramuscular fat (-0.23), and intramuscular fat and BCS (-0.64). These results suggest that selection for BCS should be effective and would result in some favorable changes in ribeye area and carcass weight but with unfavorable change in marbling.

Keywords

Cattlemen's Day, 2003; Kansas Agricultural Experiment Station contribution; no. 03-272-S; Report of progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 908; Beef; Body condition score (BCS); Carcass traits; Limousin cattle

GENETIC RELATIONSHIPS OF BODY CONDITION SCORE WITH CARCASS TRAITS IN LIMOUSIN CATTLE

D. R. Eborn and D. W. Moser

Summary

Field data from the North American Limousin Federation was used to determine the heritability and genetic correlations of body condition score (BCS) with carcass traits. Carcass traits included carcass weight, ribeye area, fat thickness, intramuscular fat, and % kidney, pelvic, and heart fat, and all were estimated to be lowly to moderately heritable (0.14 to 0.34). Heritability of BCS was 0.19. Favorable correlations existed between ribeye area and carcass weight (0.50), ribeye area and BCS (0.60), and carcass weight and BCS (0.28). Unfavorable correlations existed among ribeye area and intramuscular fat (-0.40), carcass weight and intramuscular fat (-0.23), and intramuscular fat and BCS (-0.64). These results suggest that selection for BCS should be effective and would result in some favorable changes in ribeye area and carcass weight but with unfavorable change in marbling.

Introduction

With the opportunity of increased profit through value-based marketing and with the availability of carcass expected progeny differences (EPDs), there is more selection pressure on carcass traits than ever before. Carcass traits have been reported to be from moderately to highly heritable, and selection for specific carcass endpoints has been effective. Another trait of concern for cow-calf producers is BCS. Body condition score at calving has been shown to be a good predictor of the interval to first estrus and days to pregnancy. Maintenance requirements of mature cows also change according to body condition.

We estimated the heritability and genetic correlations of BCS with carcass traits to examine how BCS is affected by carcass trait selection.

Experimental Procedures

Field data and pedigree information was obtained through the North American Limousin Federation, Englewood, CO. A total of 19,506 BCS for 12,493 cows, recorded at calf weaning on a 1 to 9 scale (1=emaciated, 9=extremely fat), were included in the analyses. The effects accounted for in the BCS model included fixed contemporary group, random animal, and repeat record, and scores were adjusted for year of age. Contemporary groups were designated by the calf's weaning weight contemporary group. All cows older than 12 years of age were placed in one age class and recorded as 12 years of age. Both linear and quadratic terms were included for age adjustments. Records on 4,326 animals were used in the carcass trait analyses. The model for carcass traits included the effects for fixed contemporary group, random animal, and a linear adjustment for days of age. Contemporary group designation included weaning weight, contemporary group, gender, and date of slaughter. Summary statistics for BCS and each carcass trait are presented in Table 1. A derivative-free restricted maximum likelihood algorithm was used to estimate variance and co-variance. Heritabilities and genetic correlations were obtained by single- and pairwise trait analyses, respectively.

Results and Discussion

Estimates of heritabilities and genetic correlations are presented in Table 2. Traits were lowly to moderately heritable (0.14 to 0.34). Ribeye area had the highest heritability estimate of 0.34, which is in agreement with reported estimates in other studies. Carcass weight (0.14) and intramuscular fat (0.15) heritabilities were lower than previously reported estimates and may reflect a Limousin breed difference. Fat thickness exhibited a moderate heritability of 0.24 and heritability for kidney, pelvic, and heart fat was 0.16. A heritability of 0.19 for BCS is in agreement with other estimates and suggests that modest genetic changes for body condition are possible through selection. Favorable carcass correlations were observed between carcass weight and ribeye area (0.50), carcass weight and kidney, pelvic, and heart fat (-0.23), ribeye area and fat thickness (-0.19), and ribeye area and kidney, pelvic, and heart fat (-0.51). Selection to increase carcass weight would be expected to increase ribeye area and decrease kidney, pelvic, and heart fat, selection to increase ribeye area would be expected to decrease fat thickness and kidney, pelvic, and heart fat. Some unfavorable genetic correlations also exist among carcass traits; the negative correlations of intramuscular fat with carcass weight (-0.23) and with ribeye area (-0.40) suggest that selection to increase muscling or weight would lower intramuscular fat. The correlation between fat thickness and intramuscular fat tended to be a negative correlation but was not significant. Favorable positive correlations were found between carcass weight and BCS (0.28) and ribeye area and BCS (0.60). A strong unfavorable correlation was obtained for BCS with intramuscular fat (-0.64), which indicates that selection for increased BCS would result in decreased marbling. This relationship was not expected.

These results suggest that carcass traits and BCS are lowly to moderately heritable and would respond to selection, but both unfavorable and favorable changes in carcass traits will result. Selection for growth and muscling would lower intramuscular fat. Selection to increase carcass weight and ribeye area would increase BCS, selection to increase BCS would decrease intramuscular fat, and selection for higher or lower BCS would not affect carcass fat thickness.

Table 1. Summary Statistics for Body Condition Score and Carcass Traits in Limousin Cattle

Trait	Average	Standard deviation	Minimum	Maximum
Cow age, year	5.7	2.7	2.0	12.0
Body condition score[a]	5.4	1.2	1.0	9.0
Carcass age, day	494.4	61.0	365.0	708.0
Carcass weight, lb	772.5	88.7	600.0	1000.0
Ribeye area, inch^2	14.5	2.0	9.1	22.8
Fat thickness, inch	0.40	0.19	0.05	1.20
Intramuscular fat score[b]	5.20	2.10	2.00	10.90
Kidney, pelvic, and heart fat, %	2.3	0.7	0.5	5.0

[a]1 = Emaciated, 5 = Moderate, 9 = Extremely Fat.
[b]2 = Practically Devoid, 5 = Small, 10 = Abundant.

Table 2. Heritabilities and Genetic Correlations for Body Condition Score (BCS) and Carcass Traits in Limousin Cattle[a]

	BCS	Carcass weight	Ribeye area	Fat thickness	Intramuscular fat[b]	KPH, %
BCS	0.19					
Carcass weight	0.28	0.14				
Ribeye area	0.60	0.50	0.34			
Fat thickness	-0.04	0.09	-0.19	0.24		
Intramuscular fat	-0.64	-0.23	-0.40	-0.14	0.15	
KPH, %	0.16	-0.23	-0.51	0.53	-0.20	0.16

[a]Heritabilities are listed on the diagonal and genetic correlations are listed below the diagonal. Heritability standard errors range from 0.02 to 0.05. Carcass trait correlation standard errors range from 0.12 to 0.20. BCS and carcass trait correlation standard errors can not be estimated.
[b]Kidney, pelvic, and heart fat.