

GENETIC CORRELATION ESTIMATES BETWEEN ULTRASOUND MEASUREMENTS ON YEARLING BULLS AND CARCASS MEASUREMENTS ON FINISHED STEERS

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Summary

Genetic parameters for yearling bull ultrasound measurements and finished steer actual carcass measurements of ribeye area, backfat thickness, and marbling score were examined. The strong positive genetic correlation estimates between steer carcass measurements and corresponding bull ultrasound measurements suggest that genetic improvement for steer carcass traits can be achieved by using bull ultrasound measurements as selection criteria.

Introduction

Genetic evaluations of carcass traits based on ultrasound measurements of yearling cattle have great potential to speed up genetic progress and reduce the expenses involved in progeny testing. Research has shown that ultrasound measured traits are heritable, and show genetic variation. However, ultrasound measurements are useful only if they can accurately predict genetic differences between carcass traits of animals reaching the marketplace – finished steers and heifers. This project studied the genetic correlations between yearling bull ultrasound measurements and finished steer carcass measurements.

Materials and Methods

Ultrasound measurements were obtained from bull-test data accumulated through the Bull Evaluation Program in Ontario, and included records from bulls tested from 1995 to 1999. A total of 5654 records were obtained on ultrasound measurements of ribeye area and backfat thickness. Of these records, 3450 also had ultrasound measurements of intramuscular fat percentage. Only purebred animals were included in the data from the following breeds in order of frequency: Limousin, Charolais, Simmental, Angus (Red and Black), Hereford, Blonde d'Aquitane, Shaver Beefblend, Gelbvieh, Salers, Shorthorn, and Maine Anjou. A trained technician took the ultrasound measurements at the end of the evaluation period.

Carcass data were obtained from 843 crossbred steers born from 1988 to 1998 at the University of Guelph's Elora Beef Research Centre (EBRC), and steers born from 1996 to 1998 at the New Liskeard Agricultural Research Station (NLARS) and Agriculture and Agri-food Canada's Kapuskasing Research Station (KAP). From 1988 to 1995, the EBRC research herd consisted of two main lines; a large rotational cross line consisting primarily of Simmental, Charolais, and Maine Anjou, and a small rotational cross line consisting primarily of Angus, Salers, and Hereford. From 1996 to 1998, the breeding program at the three research stations focused on creating one maternal line, using a two breed rotational cross of Simmental and Angus sires bred to the existing females at the research stations. Steers from the three research centres were finished at the EBRC in typical Ontario feedlot conditions, and were slaughtered when they reached approximately 7-8 mm backfat. All calves were shipped to the University of Guelph abattoir for slaughter. A Canadian Beef Grading Agency official obtained carcass measurements.

Four yearling bull traits and five finished steer traits were included in a multiple trait analysis to estimate the heritabilities and genetic correlations between the traits. Yearling bull traits were: average daily gain during the test period, ultrasound measured ribeye area, ultrasound measured backfat thickness, and ultrasound measured intramuscular fat percentage. Finished steer traits were: average daily gain during the post weaning feeding period, carcass ribeye area, carcass backfat thickness, and carcass marbling score. Both bull and steer traits were adjusted to a constant measurement age. Table 1 and 2 summarize the phenotypic characteristics of the bull and steer measurements.

Results and Discussion

The results in Table 3 and 4 show that both yearling bull ultrasound traits and finished steer carcass traits are heritable. This indicates that genetic change by selection is possible for these traits. In general, heritability estimates were similar for bull and steer traits. However, the heritability estimate for bull intramuscular fat percentage (.23) was lower than the estimate of heritability for steer marbling score (.35). This may be a result of the ultrasound equipment being less accurate for measurement of intramuscular fat percentage than other measurements. Also, yearling bulls may not be showing as much genetic variation as the older, fatter steers. Nonetheless, the heritability estimate of .23 for bull ultrasound intramuscular fat percentage is well within the acceptable range for a useful genetic evaluation.

The growth trait, average daily gain, also showed a difference in heritability between yearling bull and finished steers. The higher estimate for yearling bull gain (.46) compared to finished steer gain (.30) suggests that the bull evaluation program's standardized testing environment effectively reduces environmental variation, allowing maximum expression of genetic differences for growth traits.

Table 5 shows the genetic correlation estimates between yearling bull and finished steer carcass traits. The correlation estimates relied on pedigree relationships between the bull and steer datasets, because it is impossible to have both steer and bull traits measured on the same animal. For all

relationships, the genetic correlations were highly positive. This shows that genetic progress in steer carcass traits can be achieved by selection based on yearling bull ultrasound measurements.

Significance to the Industry

Beef cattle breeders have embraced ultrasound technology with some very warranted reservations. This research provided an answer to one of the most important questions relating to ultrasound: do ultrasound measurements of yearling bulls measure the same trait as actual carcass measurements of finished steers? From the results of this research, one could conclude that they are indeed measuring the same traits. As a result, selection of bulls based on ultrasound derived carcass trait evaluations should result in positive genetic change in steer carcass traits.

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Table 1. Summary of Finished Steer Growth and Carcass Data

Trait	Mean	SD	Min	Max
Feedlot entry weight, kg	294	43.4	176	440
Feedlot exit weight, kg	599	88.8	328	846
Time in feedlot, days	216	74.7	42	428
Slaughter age, days	470	73.2	292	703
Hot carcass weight, kg	352.3	60.10	182	532
Average daily gain, kg/day	1.46	.35	.54	2.36
Carcass ribeye area,cm ²	84.6	13.5	50.7	125.8
Carcass backfat thickness, mm	8.49	2.16	4	15
Carcass marbling score (points from 1 to 10)	4.74	.96	2	7.5

Table 2. Summary of Yearling Bull Growth and Ultrasound Data

Trait	Mean	SD	Min	Max
Start of evaluation weight, kg	352	59.9	185	590
End of evaluation weight, kg	546	68.8	345	749
Start of evaluation age, days	266	26.1	190	336
End of evaluation age, days	378	26.0	304	450
Average daily gain, kg/day	1.74	.29	.81	2.88
Ultrasound ribeye area, cm ²	81.9	11.9	45.4	117.4
Ultrasound backfat thickness, mm	4.5	1.9	1	11
Ultrasound intramuscular fat, %	3.55	.99	.71	7.19

Table 3. Estimates of Heritability (Diagonal) and Genetic Correlations (Off Diagonal) Among Yearling Bull Traits

	1.	2.	3.	4.
1. Average daily gain	.46	.21	.01	-.06
2. Ultrasound ribeye area		.48	-.03	-.33
3. Ultrasound backfat thickness			.52	.28
4. Ultrasound intramuscular fat				.23

Table 4. Estimates of Heritability (Diagonal) and Genetic Correlations (Off Diagonal) among Finished Steer Traits

	1.	2.	3.	4.
1. Average daily gain	.30	.26	.28	-.14
2. Carcass ribeye area		.45	.02	-.61
3. Carcass backfat thickness			.41	.30
4. Carcass marbling score				.35

Table 5. Estimates of Genetic Correlations Between Finished Steer and Yearling Bull Traits

Bull trait	Steer Trait	Genetic correlation
Average daily gain	Average daily gain	.72
Ultrasound ribeye area	Carcass ribeye area	.66
Ultrasound backfat thickness	Carcass backfat thickness	.88
Ultrasound intramuscular fat	Carcass marbling score	.80