Trends in Genetic Parameter Estimates for Ultrasound back Fat and Rump Fat Thickness Measures in Angus Bulls and Heifers

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Summary and Implications

The objective of the current study was to evaluate heritability and repeatability of serially measured ultrasound 12-13th rib fat thickness (UBF) and rump fat thickness (URF) measures in purebred Angus bulls and heifers. Data included 5000 observations from 912 bulls and heifers. Results from multiple trait analysis showed h^2 of 0.29 and 0.40 for yearling UBF and URF, respectively. However, the difference in h^2 estimates between yearling measures based on random regression models was smaller. At one year of age, h^2 of URF was 0.37 as compared to 0.33 for UBF. Heritability and repeatability values were at their optimum at one year of age. Therefore, yearling bull and 13 to 14 months old heifer ultrasound subcutaneous fat thickness measures from good quality images can be used to evaluate genetic potential of next generation parents in Angus cattle. Information from URF measures may not have an apparent advantage in terms of improving rate of genetic change in percentage retail product in yearling Angus cattle than what could be achieved through selecting against 12th and13th rib fat thickness.

Introduction

Currently ultrasound 12-13th rib (UBF) and rump fat thickness(URF) measures are used to evaluate genetic propensity of Angus cattle to deposit subcutaneous fat. These two indicator traits are of interest to cattle producers due to their strong genetic association with percentage of retail product (PRP). However, in the development of prediction models for PRP based on UBF, URF and other ultrasound measures, URF measures account for a smaller proportion of the variation in PRP.

Two issues remain to be explored with regard to these measures. One issue is the choice of the best time to scan cattle to allow accurate estimation of genetic differences. Currently Angus cattle are scanned for subcutaneous fat thickness and other ultrasound traits at around one year of age. This is done based on management consideration and to allow bulls and heifers differentiate genetically. However, ultrasound technology could be used to gather data at younger ages. The other issue is the justification for use of two types of subcutaneous fat thickness measures to evaluate genetic potential of Angus cattle. The issue in this case would be to check if using URF measures could accelerate genetic improvement in PRP than selection on UBF. These concerns could be resolved through evaluation of changes in genetic parameters for these two traits during the growth period spanning weaning to yearling ages. Therefore, the objective of the current study was to study heritability and repeatability of serially measured UBF and URF in purebred Angus bulls and heifers.

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Materials and Methods

Source of Data

Bulls and heifers in the present study came from the Iowa State University beef cattle breeding project. The project is designed to develop two lines of beef cattle for use as a research base to answer questions that influence genetic improvement of beef cattle. The project was initiated in 1997 with the purchase of 285 spring1996-born, purebred registered Angus heifers. Detail explanation about the herd and management practices is provided in last year's report (Hassen et al. 2003)

Serial ultrasound data were collected on progeny born at the Rhodes farm during the spring of 1998 to 2001. Each year the weaned bull and heifer calves were scanned four to six times for UBF, URF and other ultrasound traits with an average interval of 4 to 6 weeks between scans. Bulls and heifers were scanned using an Aloka 500V real-time ultrasound machine, equipped with a 3.5-MHZ, 17.2 cm linear array transducer (Coromertics Medical Systems Inc., Wallingford, CT) and Classic Scanner-200, equipped with a 3.5-MHz, 18-cm transducer (Classic Ultrasound Equipment, Tequesta, FL).

Data Analysis

The present analysis included 5000 observations from 912 bulls and heifers. Ages at scanning time were expressed in weeks and ranged from 27 to 62 weeks.

Initially, data were divided by scan session across years. Data from the first six scan sessions were analyzed using multiple trait animal model (MTM). Data pooled across years and scan were then analyzed using random regression models (RRM).

Results and Discussion

Simple statistic for data used in the current study are shown in Table 1. Data refer to means by scan session across the four-year period. Mean UBF and URF of bulls and heifers are depicted in Figure 1 and 2. Bulls deposited similar amounts of subcutaneous fat at the rump and 12-13th ribs locations until an age of 48 weeks. At later ages mean UBF values were larger. At one year of age bull measured 0.67 cm (0.26 in) and 0.65 cm (.26 in) for UBF and URF respectively. Fluctuations in mean phenotypic values at later ages could be due to a lesser number of bulls. Animals available for scanning at these ages are bulls selected for breeding and fewer light-weight bulls kept for further feeding before harvest.

Heifers also showed a similar mean UBF and URF values across ages with yearling measures of 0.68 cm (0.27 in) for both traits. Table 2 shows heritability estimates for UBF and URF measures based on multiple trait analysis. In all cases, UBF showed a lower heritability than URF measures. At the fifth scan, which is closer to yearling age, UBF and URF showed h^2 of 0.29 and 0.40, respectively. Currently, national cattle evaluation for the Angus breed use h^2 of 0.39 for a combined index of these two traits.

Figure 3 shows heritability of the two traits based on analysis of data using RRM. Heritability values are averaged by a class interval of 4 weeks. In agreement with results of MTM analysis, URF measures showed relatively higher h^2 estimates than UBF measures. However, the difference in h^2 between the two traits at one year of age was much smaller than that of MTM. At one year of age, heritability URF was 0.37 as compared to 0.33 for UBF. The results show that within the range of ages used in the current study, heritabilities of these traits were at their optimum at around one year of age. On the other hand, measurements taken at earlier ages including weaning are associated with lower heritability estimates and selection at these ages may slow genetic progress. UBF measures seem to show a relatively higher mean repeatability values at earlier ages (Figure 4). However, measures at later ages were equally repeatable for both traits. Again, repeatability values were at their optimum level at yearling age.

Generally, the current results suggest that data from bulls and heifers measured at around one year of age are good indicators of genetic potential in Angus cattle. The relatively higher h^2 of URF measures at earlier ages may be an indication that this trait may have some relevance in screening cattle at earlier ages, or in selecting cattle in a population with a relatively lower mean subcutaneous fat thickness values.

Correlated selection response in PRP as a result of selecting against subcutaneous fat depends, besides other factors, on genetic correlation of UFT and URF with PRP, and h^2 of UFT and URF. In this regard, yearling UBF measures have higher genetic correlation with PRP than those of yearling URF measures. Therefore, considering yearling measures, use of URF may not provide an additional advantage in terms of improving rate of genetic gain in PRP than what could be attained using UBF. Simulation studies are needed to provide a clear understanding of genetic changes in PRP due to selecting against UBF, URF, and an index containing both traits.

References

Hassen, A. D. E. Wilson, G. H. Rouse. 2003. Estimating heritability of percentage of intramuscular fat and ribeye area measures by scan sessions in Angus bulls and heifers. Beef Research Report. Available: http://www.iowabeefcenter.org/pdfs/BRR/. Accessed December 2003.

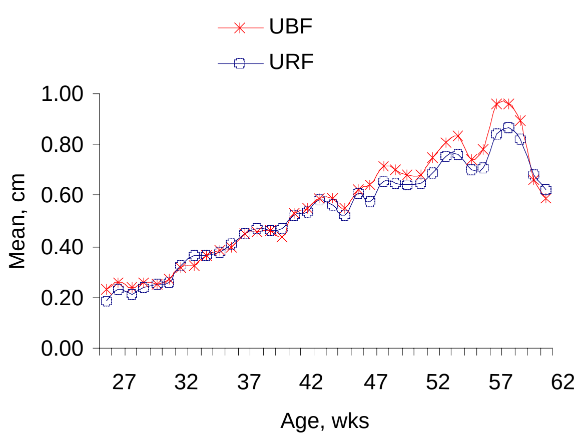
Table 1. Number of observations, mean age, UBF, and URF by scan session

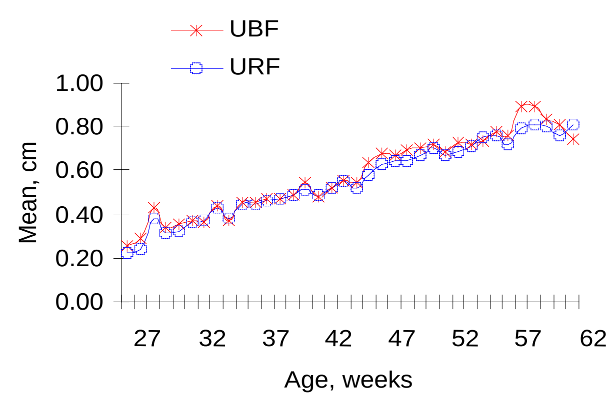
			Means (SD), cm[a]	
Scan	n	Age, d	UBF	URF
1	895	34.97 ± 3.80	0.358 ± 0.153	0.376 ± 0.165
2	909	39.64 ± 4.06	0.437 ± 0.176	0.448 ± 0.192
3	905	45.66 ± 5.47	0.571 ± 0.196	0.563 ± 0.192
4	905	50.29 ± 5.39	0.672 ± 0.221	0.645 ± 0.197
5	722	52.87 ± 4.05	0.746 ± 0.237	0.707 ± 0.211
6	570	55.85 ± 3.35	0.882 ± 0.256	0.773 ± 0.229

[a]multiply by 0.394 to convert means and SD to inches equivalent

Table 2. Heritabilities of UBF and URF measures by scan session

Scan	UBFT	URF
1	0.132 ± 0.065	0.334 ± 0.076
2	0.209 ± 0.068	0.372 ± 0.076
3	0.193 ± 0.063	0.379 ± 0.076
4	0.274 ± 0.068	0.380 ± 0.076
5	0.294 ± 0.075	0.396 ± 0.082
6	0.275 ± 0.077	0.437 ± 0.087





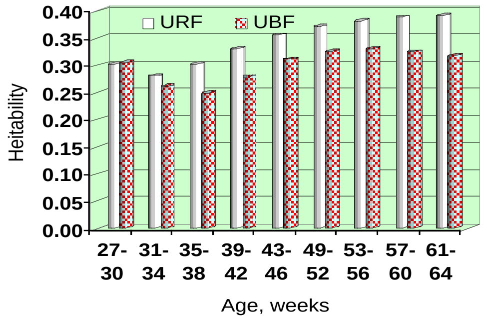


Figure 3. Heritability of UBF and URF measures

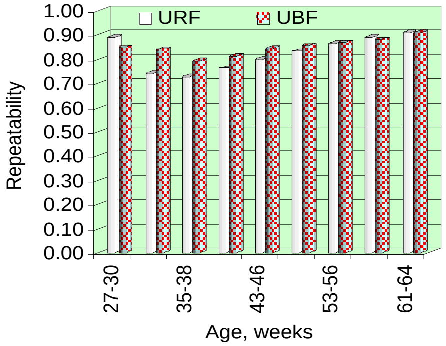


Figure 4. Repeatability of UBF and URF measures