Real-Time Ultrasound Measurements for Body Composition Traits in Iowa Cattlemen's Association Test Station Bulls

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Summary

The Iowa State University Department of Animal Science has scanned the Iowa Cattlemen's Association (ICA) centrally tested bulls for the past six years. As the beef industry moves to value-based marketing, more emphasis will be placed on carcass yield and quality traits in genetic selection decisions. Databases must be designed that will allow the beef industry to develop appropriate adjustment factors for the raw measurements. The ribeye area (REA) and percentage-fat measurements are adjusted to 365 days using a linear age-adjustment formula. The formulas are breed-specific and determined from the ICA bull-scanning database. External fat thickness is not adjusted. The common endpoint allows for a more direct comparison of the bulls. Sufficient real-time ultrasound data taken on the ICA test bulls exist to develop linear age-adjustment factors for at least three breeds: Angus, Charolais, and Simmental.

Introduction

The Iowa State University Department of Animal Science has scanned the Iowa Cattlemen's Association centrally tested bulls for the past six years. The scanning began in 1991 when the bulls from one of the four test stations were scanned as a trial program. The scanning was expanded in 1992 to all test locations and has continued through the 1996 test year. As the beef industry moves to value-based marketing, more emphasis will be placed on carcass yield and quality traits in genetic selection decisions. Data bases need to be developed that will allow the beef industry to develop appropriate adjustment factors for the raw measurements. The purpose of this report is to provide a summary of the ultrasound measurements taken on the yearling bulls and to report on some of the adjustment factors being developed.

Materials and Methods

ICA normally has bulls located at four different test sites in Iowa. The bulls go on test in late fall and start coming off test in February. The last off-test weighing normally occurs in April. The bulls are scanned on the day immediately following the last off-test weigh day. Normally, two images are collected for each bull using an Aloka 500v real-time ultrasound machine with a 17cm transducer. The first image is a cross-sectional image taken between the 12th and 13th ribs of the animal. This image is taken with a wave guide between the transducer and a well-oiled and clipped location on the animal. This first image is used to measure external fat thickness and ribeye area (REA). The second image is taken longitudinally without the wave guide across the 11-13th ribs of the animal at a position three-fourths of the distance from the chine end of the ribeye muscle. A wave guide is not used on the second image. The second image is used in the prediction of the percentage of intramuscular fat (%-fat) in the ribeye muscle. The %-fat is positively related to the USDA marbling score. In 1996, rump fat measurements were collected for the first time. The images are digitized and stored on a PC hard disk using ISU developed software. The digitized images are taken to the Imaging Laboratory, located in Kildee Hall on the ISU Campus, for interpretation and analysis.

All image interpretation is accomplished using ISU developed software. The interpretations are done by ISU personnel that are currently Beef Improvement Federation Certified Ultrasound Technicians. The individual bull measurements are returned to the ICA with 48 hours after collection. This information is then added to the sale catalogue to assist bull buyers in their selection decisions.

The REA and %-fat measurements are adjusted to 365 days using a linear age adjustment formula. The formulas are breed specific and determined from the ICA bull scanning data base. External fat thickness is not adjusted.

Results and Discussion

A summarization of the breed average ultrasound measurements is given in Table 1. This summarization includes all of the measurements made from 1992 to 1996. There are some within year differences amongst the averages, but it is felt that the across year averages are more representative of breed differences. Rump fat measurements were taken because there is some research that would indicate an additional fat thickness measurement could be helpful in predicting percentage retail product. The correlations between rump fat thickness and 12-13th rib fat thickness within breed is presented in Table 1.

It is important to be able to adjust ultrasound measured traits to a common end point. The common end point allows for a more direct comparison of the bulls. For at least a few of the breeds being sampled in the ICA bull tests, sufficient numbers exist to develop some breed specific adjustment procedures. Age is being used as the end point for REA and %-fat. The procedure for developing the adjustment formula is to determine a 0-day age intercept within breed using the GLM procedure of SAS and to combine this with the bull's individual growth rate. The only effect considered in the model is age, and the analysis is done within each breed.

The adjusted value then is a combination of a breed effect and the individual's own performance. The results are presented in Table 2. It is recommended that only those adjustments with a regression model Pr > F value of .05 or less be used. An example adjustment formula for an Angus REA follows:

REA_{365}, sq. inches = 5.327 + [(REA_{actual} - 5.327) /age] * 365

An alternative GLM analysis to that discussed in the previous paragraph is to fit other fixed effects along with age, for example including Test Year and Test Location. The resulting intercept values are biased and are not unique, however, they do correlate very well with those estimated from the first procedure. The intercepts are typically regressed towards zero as compared with the first procedure estimates. The results are presented in Table 3. The biggest concern with using results from this model is the limited amount of data being used to estimate model parameters.

Trends of phenotypic RTU measurements for two different breeds are presented in Figures 1-3 for 12-13th rib fat thickness, ribeye area and %-fat (marbling). Only these breeds are presented because of having sufficient numbers to plot by year. Even for these two breeds, one needs to be cautious in drawing any conclusions because of the influence that year-effects (location, weather, management, etc.) have on the results. It is also noted that %-fat prediction models have been upgraded over time, meaning that the trends could be more indicative of improvement in prediction accuracy and much less indicative of any real trend in actual increases in the bulls being scanned.

Acknowledgments

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Table 1. Real-time ultrasound measurements by breed for Iowa Cattlemen's Association Test Station bulls.

Breed	Number[1]	Age, days	12-13th rib fat thickness, in.	Rump fat thickness, in.	Ribeye area, sq. in.	%-fat, %	Correlation, rump vs. 12-13th rib
Angus	901 (189)	367±25	.34±.10	.38±.10	12.10±1.36	2.77±.96	.68
Charolais	274 (71)	362±23	.20±.06	.21±.06	13.03±1.36	2.17±.18	.52
Gelbveih	159 (26)	371±26	.18±.06	.23±.07	12.72±1.43	2.23±.82	.67
Limousin	97 (15)	365±24	.19±.05	.24±.09	13.79±1.69	1.95±.71	.74
Maine Anjou	38 (4)	387±19	.20±.05	.27±.06	13.32±1.50	2.61±.62	.57
Polled Hereford	54 (14)	364±25	.30±.10	.36±.12	11.36±1.39	2.49±.76	.68
Red Angus	17 (0)	349±15	.27±.07		10.84±1.31	2.08±.26	
Salers	97 (10)	362±19	.20±.07	.21±.06	13.00±1.28	2.05±.91	.49
Shorthorn	30 (4)	352±21	.24±.08	.31±.03	11.44±1.37	2.22±.59	.47
Simmental	499 (75)	369±25	.18±.06	.20±.08	12.96±1.42	2.23±.82	.58

[1]Number in parenthesis is for rump fat measurements.

Table 2. Linear adjustments for ultrasound measurements in yearling bulls fitting only age in the GLM model.

	Intercept, 0 days of age				Intercept, 0 days of age			
Breed	Ribeye area, sq. in.	R^2	Pr>F	b_{age}	%-fat, %	R^2	Pr>F	b_{age}
Angus	5.122	.13	.0001	.0189	-1.433	.08	.0001	.0114
Charolais	5.635	.12	.0001	.0204	-1.792	.09	.0001	.0110
Gelbveih	4.641	.16	.0001	.0217	-.997	.07	.0046	.0087
Limousin	5.226	.11	.0009	.0234	-.485	.05	.0360	.0067
Maine Anjou								
P. Hereford	5.117	.09	.0218	.0171	-2.185	.21	.0029	.1275
Red Angus								
Salers	4.259	.14	.0002	.0241	-5.272	.19	.0012	.0200
Shorthorn								
Simmental	4.564	.10	.0001	.0173	-1.721	.12	.0001	.0107

Table 3. GLM analysis of real-time ultrasound measurements fitting test year and location as fixed effects and age as a covariate within breed.

Breed	R^2	Model Pr>F	Intercept, 0 days of age	Pr>|T|	b_{age}	Pr>|T|
Ribeye area:						
Angus	.21	.0001	5.327	.0001	.0177	.0001
Charolais	.22	.0001	5.506	.0001`	.0199	.0001
Gelbveih	.22	.0001	3.841	.0335	.0230	.0001
Limousin	.40	.0001	7.553	.0019	.0171	.0101
Maine Anjou	.43	.0020	2.143	.6533	.0306	.0246
P. Hereford	.32	.0018	4.357	.0831	.0181	.0092
Red Angus	.47	.0366	4.273	.5172	.0147	.4257
Salers	.36	.0001	5.267	.0362	.0206	.0023
Shorthorn	.47	.0069	3.064	.4721	.0240	.0518
Simmental	.21	.0001	7.239	.0001	.0149	.0001
%-fat:						
Angus	.48	.0001	-.6139	.1993	.0108	.0001
Charolais	.53	.0001	-.6544	.3454	.0094	.0001
Gelbveih	.46	.0001	-1.038	.3477	.0106	.0003
Limousin	.48	.0001	0.5081	.6102	.0086	.0026
Maine Anjou	.77	.0001	-1.4943	.2688	.0132	.0011
P. Hereford	.58	.0001	-1.5531	.1833	.1027	.0002
Red Angus						
Salers	.62	.0001	-3.1716	.0947	.0103	.0469
Shorthorn	.44	.0259	-2.0506	.3242	.0138	.0254
Simmental	.47	.0001	-1.4561	.0036	.0115	.0001

Figure 1. Trends in RTU 12-13th rib fat thickness for Angus and Simmental yearling bulls.

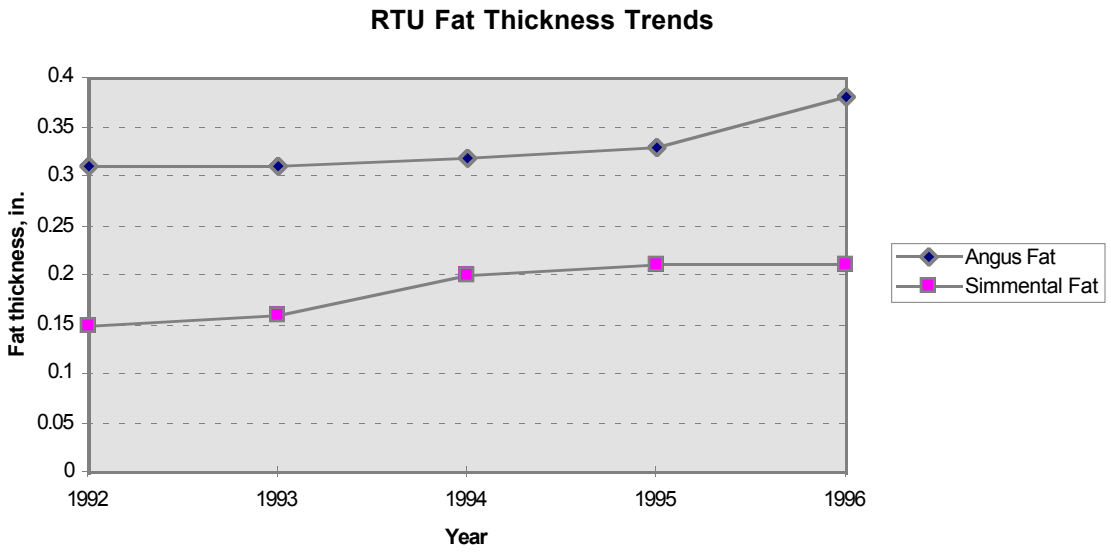

Figure 2. Trends in RTU ribeye area for Angus and Simmental yearling bulls.

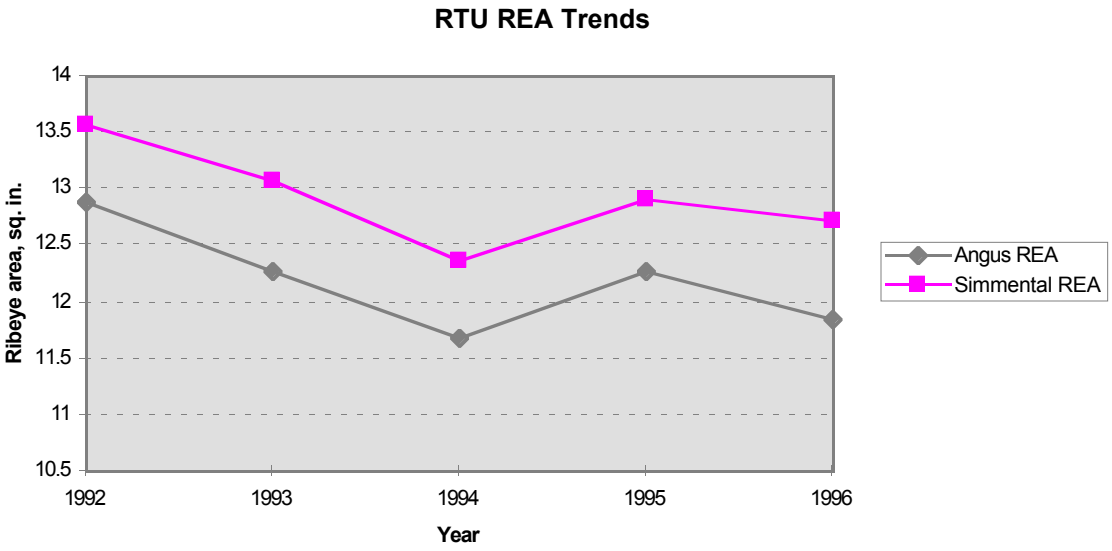

Figure 3. Trends in RTU percentage of intramuscular fat (marbling) for Angus and Simmental yearling bulls.