The Accuracy of Real-Time Ultrasound Measurements for Body Composition Traits with Carcass Traits in Feedlot Heifers

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Summary

This study compared ultrasound measurements of body composition to carcass measurements of 145 heifers harvested in five groups. Results show that this technology can accurately measure URIBFT, UREA, and UMARB prior to slaughter. URIBFT was the trait that had the highest correlations and acceptable standard error of predictions (SEPs) and bias. The other two traits, UREA and UMARB, had lower correlation values but acceptable SEPs and bias. Real-time ultrasound is an accurate tool to measure body composition and can be used very effectively as a selection or sorting tool in the feedlot.

Introduction

Real-time ultrasound has been used in the beef cattle industry since the 1950's. Earlier it was used as an A-mode machine which was only capable of measuring backfat and muscle depth. Today the machines used are B-mode (in real-time) machines which are capable of measuring backfat and ribeye area, also these machines have the capability of collecting images that are used to measure percent intramuscular fat, which is analyzed with proper software. Ultrasound measurements are very useful for the seedstock industry, generating EPDs and helping to select superior animals for body composition traits. Ultrasound is also being used in feedlots as a sorting tool and can help producers to avoid discounts and increase profit. However, measurements with ultrasound are only meaningful if accurate.

Materials and Methods

One hundred forty-five (145) heifers were used in this experiment. These heifers were used for other experiments during the years 2002, 2003, and 2004. The heifers used in this experiment had both ultrasound and carcass data. There were 32 heifers in 2002, 19 heifers in 2003, and 94 heifers in 2004. Heifers were scanned from 2 to 11 days prior to harvest.

Heifers were scanned by an Annual Proficiency Testing and Certification (APTC)/Ultrasound Guidelines Council (UGC) field certified technician. A Classic Scanner 200 (Classic Medical Supply, Tequesta, FL) with a 3.5 MHz 18 cm animal science probe attached was used to collect images on all animals. Images were brought back to the Iowa State University image interpretation lab and interpreted by an APTC/UGC lab certified technician with software developed by Iowa State University. Ultrasound measurements collected were: live weight (SCANWT), 12th rib fat thickness (URIBFT), 12th rib ribeye area (UREA), and percent intramuscular fat (UPFAT). Ultrasound measures of UPFAT were converted to marbling score units using the linear equation: ultrasound marbling (UMARB) = ((769.7 + (56.69 * UPFAT))/100) – 5.

Carcass measurements were collected by trained personnel from Iowa State University and Iowa Quality Beef at line speed under typical circumstances for commercial carcass data reported to producers. Carcass measures collected were: hot carcass weight (HCW), carcass ribeye area (CREA), carcass 12th rib fat thickness (CFT) and marbling scores (CMS). Marbling scores were called by the USDA grader to the nearest 10th of a marbling degree and were converted to a numeric marbling score with Small^{00} = 5.00.

During 2004 there were 3 different harvest groups, and accuracy calculations were made for each group. Animals were deleted if there was no carcass data available for comparison.

Results and Discussion

Table 1 shows the simple statistics for ultrasound measurements and carcass measurements. Simple correlations between live animal and carcass traits are presented in Tables 2 to 7. Table 8 shows the technician bias (ultrasound – carcass), correlation, and standard error of prediction (SEP). Results from Table 8 show that the strongest correlated trait is URIBFT with correlations ranging from 0.61 to 0.85 and SEP lower than 0.13 in. UREA and UMARB correlations are very similar on average and range from 0.35 to 0.66 and 0.48 to 0.76, respectively. SEP are all lower than 1.23 in^2 and 1.01 marbling score units, respectively. Among the individual harvest groups, URIBFT and UMARB more often over predicted CRIBFT and CMARB, while UREA more often under predicted CREA. Interestingly, the fattest group, 2004 harvest 3, had the lowest correlation and largest SEP for UMARB. Also, the harvest group with the least variation in CMS, 2004 harvest 1, had the smallest SEP for UMARB.

These results are expected since URIBFT is easier to measure than UREA and UMARB. UREA correlations are not as high as expected, however, errors in carcass measurements on moving carcasses are possible, and this could account for the lower values. Overall UMARB correlation was not as high as we anticipated, this might be attributable to different graders calling the marbling scores across harvest dates, indicated by each harvest group correlation being higher than the pooled dataset. It could also be that ultrasound is predicting percent intramuscular fat and then this measure is being used to estimate USDA marbling score.

Implications

Based on the results of this experiment, we conclude that real-time ultrasound is an accurate tool to measure body composition in beef feedlot heifers. Accuracy and precision statistics are reasonable across all five independent harvest groups as well as the pooled data. If data is to be used as a sorting tool in feedlots there is no requirement to use a certified technician, but it is always good to ensure that the technician has proper experience if not certified.

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Iowa Quality Beef, Ames, IA

Table 1. Simple statistics for live animal ultrasound and carcass traits.

	SCANWT, lb	URIBFT, in	UREA, in^2	UMARB[a,b]	HCW, lb	CFT, in	CREA, in^2	CMS[b]
Overall (n = 145)								
Mean	1072	0.53	11.92	6.58	661	0.51	11.92	6.25
SD	114	0.17	1.18	0.70	67	0.17	1.17	1.11
2002 (n = 32)								
Mean	1049	0.47	11.70	6.56	657	0.44	11.74	6.95
SD	82	0.12	1.26	0.64	52	0.10	0.84	1.13
2003 (n = 19)								
Mean	955	0.42	11.65	6.34	594	0.36	11.00	6.74
SD	50	0.12	1.20	0.55	32	0.09	0.91	0.87
2004 harvest 1 (n = 26)								
Mean	1098	0.50	12.20	6.41	667	0.43	12.41	5.40
SD	79	0.13	1.04	0.57	50	0.14	1.12	0.58
2004 harvest 2 (n = 20)								
Mean	945	0.43	10.70	6.41	588	0.46	10.85	5.88
SD	65	0.12	0.69	0.71	48	0.11	0.92	0.75
2004 harvest 3 (n = 48)								
Mean	1173	0.66	12.54	6.86	718	0.68	12.58	6.21
SD	78	0.17	0.87	0.78	44	0.13	0.96	1.16

[a] UMARB = ((769.7 + (56.69 * UPFAT,%)) / 100) - 5
[b]Traces^{00} =3.00, Slight^{00} = 4.00, Small^{00} = 5.00, Modest^{00} = 6.00, Moderate^{00} = 7.00

Table 2. Overall simple correlations between live animal and carcass collected traits (n = 145).

Trait	HCW, lb	CREA, in^2	CFT, in	CMS[a]
SCANWT, lb	0.95***	0.64***	0.50***	-0.13
UREA, in^2	0.51***	0.66***	0.22**	-0.05
URIBFAT, in	0.47***	0.19*	0.80***	-0.03
UMARB[a]	0.13	0.06	0.27**	0.48***

[a]Traces^{00} =3.00, Slight^{00} = 4.00, Small^{00} = 5.00, Modest^{00} = 6.00, Moderate^{00} = 7.00
*** P < 0.001; ** P < 0.01; * P < 0.05; † P < 0.10

Table 3. Simple correlations between live animal and carcass collected traits for 2002 (n = 32).

Trait	HCW, lb	CREA, in^2	CFT, in	CMS[a]
SCANWT, lb	0.93***	0.36*	0.26	-0.18
UREA, in^2	0.43*	0.66***	-0.05	-0.17
URIBFAT, in	0.33	0.13	0.71***	-0.06
UMARB[a]	0.34	0.19	0.00	0.53**

[a]Traces^{00} =3.00, Slight^{00} = 4.00, Small^{00} = 5.00, Modest^{00} = 6.00, Moderate^{00} = 7.00
*** P < 0.001; ** P < 0.01; * P < 0.05; † P < 0.10

Table 4. Simple correlations between live animal and carcass collected traits for 2003 (n = 19).

Trait	HCW, lb	CREA, in^2	CFT, in	CMS[a]
SCANWT, lb	0.89***	0.34*	-0.30	-0.00
UREA, in^2	0.30	0.61**	0.06	0.04
URIBFAT, in	-0.25	-0.49	0.85***	0.31
UMARB[a]	-0.44†	-0.23	0.50*	0.56*

[a]Traces^{00} =3.00, Slight^{00} = 4.00, Small^{00} = 5.00, Modest^{00} = 6.00, Moderate^{00} = 7.00
*** P < 0.001; ** P < 0.01; * P < 0.05; † P < 0.10

Table 5. Simple correlations between live animal and carcass collected traits for 2004 harvest 1 (n = 26).

Trait	HCW, lb	CREA, in^2	CFT, in	CMS[a]
SCANWT, lb	0.93***	0.69***	-0.07	-0.16
UREA, in^2	0.44*	0.35†	0.27	0.06
URIBFAT, in	0.16	-0.13	0.79***	0.16
UMARB[a]	-0.03	-0.01	0.47*	0.70***

[a]Traces^{00} =3.00, Slight^{00} = 4.00, Small^{00} = 5.00, Modest^{00} = 6.00, Moderate^{00} = 7.00
*** P < 0.001; ** P < 0.01; * P < 0.05; † P < 0.10

Table 6. Simple correlations between live animal and carcass collected traits for 2004 harvest 2 (n = 20).

Trait	HCW, lb	CREA, in^2	CFT, in	CMS[a]
SCANWT, lb	0.87***	0.61*	-0.24	-0.10
UREA, in^2	0.64**	0.56*	0.12	-0.14
URIBFAT, in	0.09	-0.15	0.61**	0.27
UMARB[a]	-0.44*	-0.41†	-0.11	0.76***

[a]Traces^{00} =3.00, Slight^{00} = 4.00, Small^{00} = 5.00, Modest^{00} = 6.00, Moderate^{00} = 7.00
*** P < 0.001; ** P < 0.01; * P < 0.05; † P < 0.10

Table 7. Simple correlations between live animal and carcass collected traits for 2004 harvest 3 (n = 48).

Trait	HCW, lb	CREA, in^2	CFT, in	CMS[a]
SCANWT, lb	0.89***	0.13	0.26†	-0.05
UREA, in^2	-0.05	0.60***	-0.33*	0.08
URIBFAT, in	0.11	-0.20	0.66***	-0.05
UMARB[a]	-0.19	-0.11	-0.05	0.51***

[a]Traces^{00} = 3.00, Slight^{00} = 4.00, Small^{00} = 5.00, Modest^{00} = 6.00, Moderate^{00} = 7.00
*** P < 0.001; ** P < 0.01; * P < 0.05; † P < 0.10

Table 8. Accuracy statistics of ultrasound measurements compared to carcass measurements.

	URIBFT, in	UREA, in^2	UMARB[a]
All data (n = 145)			
Bias	0.02	0.00	0.33
Correlation	0.80	0.66	0.48
SEP	0.11	0.97	0.99
2002 (n = 32)			
Bias	0.03	-0.05	-0.40
Correlation	0.71	0.66	0.53
SEP	0.09	0.95	0.95
2003 (n = 19)			
Bias	0.06	0.66	-0.40
Correlation	0.85	0.61	0.56
SEP	0.06	0.97	0.73
2004 harvest 1 (n = 26)			
Bias	0.08	-0.22	1.02
Correlation	0.79	0.35	0.69
SEP	0.09	1.23	0.45
2004 harvest 2 (n = 20)			
Bias	-0.03	-0.15	0.53
Correlation	0.61	0.56	0.76
SEP	0.10	0.78	0.51
2004 harvest 3 (n = 48)			
Bias	-0.02	-0.04	0.65
Correlation	0.66	0.60	0.51
SEP	0.13	0.82	1.01

[a]Traces^{00} =3.00, Slight^{00} = 4.00, Small^{00} = 5.00, Modest^{00} = 6.00, Moderate^{00} = 7.00