Comparison of ninth-tenth-eleventh rib section to carcass components in serially harvested steer carcasses

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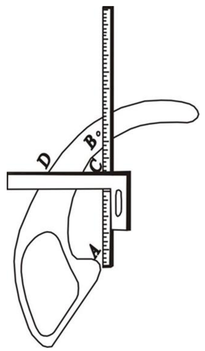
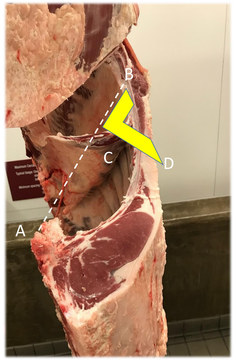
Introduction

- Researchers in the 1920's and 1930's recognized the need for estimating proportions of lean, fat, and bone in beef animals
- Lush (1926) was one of the first researchers to identify a low cost method to quantify estimations of beef fat from carcasses at a commercial level
- The 1935 report from the chief of the bureau of animal industry (USDA) stated the efficacy of using the 9-10-11th rib section of carcasses as an accurate method of estimating bone percentage
- Hankins and Howe (1946) used the 9-10-11th rib section as an estimation of carcass components (lean, fat, bone, and proximate analysis)
- Accuracy of the low cost methods have varying levels of efficacy for evaluation of whole carcass composition
- **Objective**: Compare separable lean, fat, bone, and proximate analysis between the 9-10-11th rib section and the carcass

Methods

- Charolais x Angus steers (*n* = 80) were randomly allocated to implant treatments and harvest date in a 2 x 10 factorial design
- Implant treatments administered were Revalor-XS (REV n = 40; 200mg trenbolone acetate/40mg estradiol) implanted on d0 and d190 or no implant as a control group (CON; n = 40)
- Right sides of the carcass were weighed to the nearest 0.05 kg ± 0.005 kg before separation into lean, fat, and bone (Wesley, 2020)
  - Proximate analysis was determined from samples of lean, fat, and bone
- Rib samples were collected from the left half of each carcass and weighed whole prior to separation of lean, fat, and bone; weights were recorded to the nearest 0.05 grams
  - Rib samples were dissected using the Hankins and Howe (1946) method:
    - Measurements from point A to point B; from the topmost point of the split thoracic vertebrae to the cartilage button of the 13th rib
    - Point C was calculated as 61.5% of the distance (mm) between point A and B
    - Point D was measured by placing a carpenter square at the calculated distance of point C to the external intersect perpendicular to the external face





- Fat consisted of subcutaneous, intermuscular, and intramuscular depots per Hankins and Howe (1946)
- Lean and fat for proximate analysis were ground until considered homogenous; bone was fine ground on a band saw until reaching a consistent powder
  - Proximate analysis was completed by SDK Laboratories (Hutcheson, KS)

Results

Table 4.1. Simple correlations of rib section components to carcass components as a percent

	Carcass Lean	Carcass Fat	Carcass Bone	Carcass Moisture	Carcass Ether Extract	Carcass Crude Protein	Carcass Ash
Rib Lean	**0.62*** **	-0.81***	0.49***	0.70***	-0.79***	0.51***	0.04
Rib Fat	-0.611***	**0.86*** **	-0.56***	-0.79***	0.86***	-0.58***	-0.03
Rib Bone	0.42***	-0.64***	**0.47*** **	0.56***	-0.63***	0.40***	0.09
Rib Moisture	0.62***	-0.86***	0.57***	**0.78*** **	-0.85***	0.61***	0.08
Rib Ether Extract	-0.62***	0.88***	-0.58***	-0.81***	**0.88*** **	-0.63***	-0.05
Rib Crude Protein	0.54***	-0.79***	0.53***	0.68***	-0.77***	**0.51*** **	0.07
Rib Ash	-0.01	-0.18	0.16	0.01	-0.15	-0.02	**0.18**

P < 0.001, ***

Table 4.2. Effects of days on feed (DOF) and Revalor-XS on 9-10-11th rib section components of Angus x Charolais steers fed over a 378-d serial harvest period

	Treatment			DOF												*P*-value		
Item	Control	RevalorXS	SEM	0	42	84	126	168	210	252	294	336	378	SEM	REV	DOF	REV×DOF	Linear	Quadratic
n	40	40	--	8	8	8	8	8	8	8	8	8	8	--	--	--	--	--	--
Ash%	4.60	4.55	0.002	5.34	4.53	4.09	4.01	4.76	4.78	4.36	4.98	4.59	4.29	0.003	0.80	0.19	0.06	0.56	0.35
Ether Extract%	30.74	29.97	0.009	12.54	19.57	23.24	28.24	32.17	34.30	37.57	40.75	37.53	37.61	0.01	0.42	<0.01	0.05	<0.01	<0.01
Crude Protein%	15.92	15.73	0.003	19.54	17.28	17.12	15.84	15.27	15.22	14.60	14.60	14.12	14.66	0.004	0.53	<0.01	0.06	<0.01	<0.01
Moisture%	46.07	46.29	0.005	57.49	53.34	52.48	47.26	44.08	43.11	41.42	39.82	40.02	42.76	0.01	0.77	<0.01	0.08	<0.01	<0.01
Lean%	47.77	48.29	0.01	59.92	53.11	52.16	49.08	44.72	44.93	44.64	42.19	43.69	45.91	0.01	0.61	<0.01	0.11	<0.01	<0.01
Fat%	30.91	30.86	0.008	11.58	20.18	24.34	29.04	34.48	34.95	38.15	40.45	37.49	38.20	0.01	0.97	<0.01	0.06	<0.01	<0.01
Bone%	19.44	18.32	0.007	25.13	22.40	21.31	17.96	18.34	18.11	15.83	17.64	16.11	15.97	0.01	0.13	<0.01	0.18	<0.01	0.01

Table 4.3. Effects of days on feed (DOF) and Revalor-XS on carcass components of Angus x Charolais steers fed over a 378-d serial harvest period

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Item	Control	RevalorXS	SEM	0	42	84	126	168	210	252	294	336	378	SEM	REV	DOF	REV×DOF	Linear	Quadratic
n	40	40	--	8	8	8	8	8	8	8	8	8	8	--	--	--	--	--	--
Ash%	5.71	6.08	0.001	5.81	6.28	5.70	5.41	6.16	5.81	6.47	5.36	5.87	6.12	0.003	0.01	0.40	0.04	0.87	0.74
Ether Extract%	25.77	23.79	0.007	12.47	17.97	20.02	24.33	23.67	26.79	30.86	32.81	29.65	29.21	0.01	0.01	<0.01	0.15	<0.01	<0.01
Crude Protein%	16.33	16.74	0.002	17.65	17.82	18.12	16.82	17.08	15.70	15.98	15.06	15.59	15.51	0.004	0.14	<0.01	0.61	<0.01	0.53
Moisture%	50.63	51.16	0.007	58.47	56.99	54.71	50.07	50.07	50.35	48.17	54.48	46.34	48.33	0.01	0.43	<0.01	0.05	<0.01	<0.01
Lean%	60.03	60.52	0.009	64.93	65.58	64.21	59.13	58.63	60.07	61.36	54.95	55.44	58.41	0.02	0.59	<0.01	0.54	<0.01	0.18
Fat%	19.27	18.16	0.008	7.36	11.59	13.90	19.69	19.50	19.66	20.87	27.08	24.24	23.23	0.01	0.16	<0.01	0.65	<0.01	<0.01
Bone%	19.14	19.10	0.003	22.17	21.86	20.44	17.90	18.80	18.86	19.28	16.66	17.79	17.45	0.008	0.87	<0.01	<0.01	<0.01	0.07

- Figures represent WTAMU results as well as the original prediction models from Hankins and Howe (1946)
- Fat percentage was strongly correlated (r = 0.86) between rib sections and carcasses
- Carcass to rib moisture was moderately correlated (r = 0.78)
- Lean and bone percentage were moderately but not closely correlated (r = 0.57 and 0.47, respectively)
- Carcass crude protein and ash were poorly correlated to rib sections (r = 0.51 and 0.18 respectively)
- Ether extract was the highest correlated parameter between carcass and rib sections (r = 0.88)
- No treatment effects were observed in rib components (*P* ≥ 0.13), however treatment effects were observed in ash and ether extract in carcass components (*P* < 0.01)
- Both rib and carcass components were observed to have DOF effects (*P* < 0.01) for all components excluding ash
- Interaction between TRT × DOF for ash, moisture, and bone were observed in carcass components (*P* = 0.04, 0.05, and <0.01, respectively) but were not observed in rib sections
- Rib section TRT × DOF interactions were observed for ether extract (*P* = 0.05)

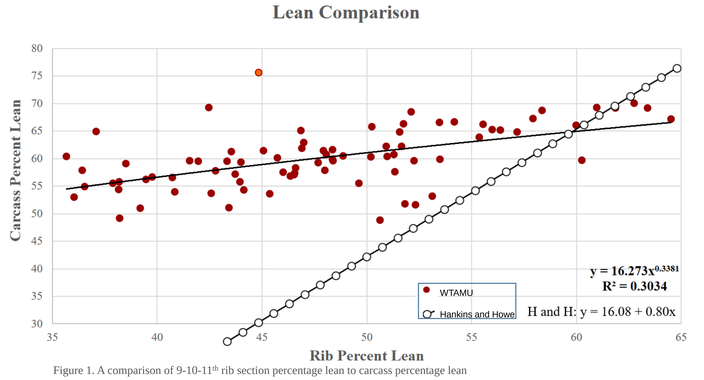

Figure 1. A comparison of 9-10-11th rib section percentage lean to carcass percentage lean

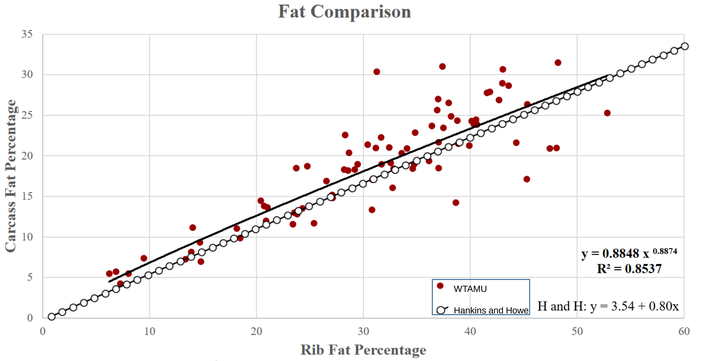

Figure 2. A comparison of 9-10-11th rib section percentage fat to carcass percentage fat

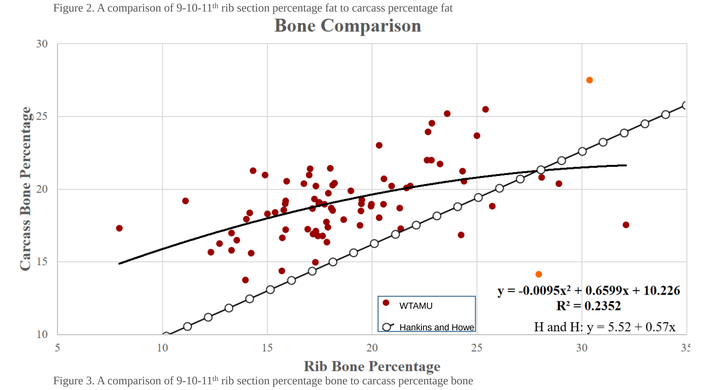

Figure 3. A comparison of 9-10-11th rib section percentage bone to carcass percentage bone

Discussion and Conclusions

- Proximate analysis represented more differentiation between carcass and rib section components than the Hankins and Howe (1946) report
- The 9-10-11th rib section was a poor representation for carcass parameters in this study, with the exception of fat (r = 0.86) and ether extract (r = 0.88)
- Results from other studies have also reported inaccuracies of using this method (Crouse and Dikeman, 1974; Nour and Thonney, 1994; McEvers et al., 2018)