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The Relationship of Beef Primal Cut Composition to Overall Carcass Composition

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Strong relationships exist between composition of individual beef primals and total carcass composition.

Summary

The amount of lean, subcutaneous fat, seam fat and bone of each of the four major primal cuts (round, rib, loin and chuck) were used in combination with yield grade to predict total side composition. The makeup of each primal is highly related to total carcass composition. The decision of which primal to fabricate depends on the sex of the animal and which component (lean, subcutaneous fat, seam fat or bone) is of greatest interest.

Introduction

The ability to identify composition of a beef carcass is a valuable research tool. Many research trials require accurate determination of beef carcass composition. Yet, total dissection of a carcass is costly and time consuming. The costly process of whole carcass analysis might be alleviated through physical separation of a specific primal cut. By dissecting a small portion of the carcass into lean, subcutaneous fat, seam fat and bone, it may be possible to estimate the proportion of these components for the whole carcass. In this study, the round, rib, loin and chuck were physically separated to determine which cut best represents the composition of the entire beef carcass.

Procedure

Right sides from steer (n=53) and heifer (n=38) carcasses varying widely in carcass weight (504-1,007 lb) and fat thickness (.10-1.13 inch) were evaluated. No discernible Brahman or dairy breeding was present in these cattle. Yield grade factors were measured and sides were separated into the primal round, loin, rib, chuck and remaining cuts. Each primal along with the remaining cuts was physically separated into lean, subcutaneous fat, seam fat and bone. Composition of each of the four major primals was used in combination with yield grade to predict side composition.

Statistical Analysis

Prediction equations were developed using lean, subcutaneous fat, seam fat and bone of each primal as a means

Table 1. Beef side lean, subcutaneous fat, seam fat and bone percentage for steers and heifers.

Sex class	Component	Mean value	SD	Minimum	Maximum
Steers	Lean	55.5	3.6	47.6	65.3
n = 53	Subcutaneous fat	9.0	2.2	3.5	13.1
	Seam fat	16.2	2.4	11.2	22.6
	Bone	16.5	1.6	13.0	20.3
Heifers	Lean	53.6	5.0	46.4	65.2
n = 38	Subcutaneous fat	10.1	3.3	2.9	14.9
	Seam fat	17.4	3.7	8.7	23.3
	Bone	15.4	2.7	11.9	23.6

Table 2. Percentage* of primal lean, subcutaneous fat, seam fat or bone for steers and heifers.

Sex class		Lean		Subcutaneous fat		Seam fat		Bone	
	Primal	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Steers,	Round	62.18	3.23	11.43	2.93	8.27	1.42	17.60	1.72
n=53	Loin	59.34	4.29	10.84	3.55	11.49	1.99	17.92	2.31
	Rib	51.51	4.14	10.14	2.95	17.52	3.36	20.40	2.57
	Chuck	62.01	3.01	4.38	1.55	16.05	2.91	17.36	1.71
Heifers,	Round	63.14	3.45	11.20	3.53	8.24	1.61	16.60	2.10
n=38	Loin	58.47	5.03	12.10	5.41	12.22	2.92	16.68	3.60
	Rib	50.27	5.71	10.60	3.88	18.84	4.80	19.76	3.57
	Chuck	60.42	3.97	5.05	2.02	17.65	4.09	16.54	2.68

*The difference between 100 percent and the sum of the components reflects moisture and cutting loss for each primal.

Table 3. Coefficients of determination of lean, subcutaneous fat, seam fat and bone for steer and heifer carcasses

Sex class	Primal	Lean,%	Subcutaneous fat,%	Seam fat,%	Bone,%
Steers,	Round	77.3	81.0	70.6	76.0
n=53	Loin	85.6	89.5	84.6	73.8
	Rib	80.8	71.7	80.0	55.0
	Chuck	82.1	72.2	91.5	81.6
Heifer,	Round	90.0	88.1	86.1	88.8
n=38	Loin	85.3	88.7	89.7	87.2
	Rib	91.6	88.9	92.6	90.6
	Chuck	91.5	90.0	93.3	86.3

to determine their relationships to the entire carcass. Coefficients of determinations (CD) obtained through regression analysis were used to identify amount of variation in carcass composition explained by the individual primal. The closer the CD is to 100, the better the relationship.

Results

Carcasses of both sex classes in this study were widely variable in weight and composition. Steer carcasses ranged in weight from 554 to 936 pounds and in lean percentage from 47.6 to 65.3. Heifer carcasses ranged from 504 to 1,007 pounds and 46.4 to 65.2 percent lean (Table 1).

Composition of the individual primals revealed the lowest proportion of lean and the highest proportion of the seam fat and bone in the rib, the lowest subcutaneous fat percentage in the chuck and the lowest seam fat percentage in the round (Table 2). The non-uniform distribution of these tissues across the primal cuts formed the basis for this research to determine which primal best represented total carcass composition.

Prediction of carcass lean

Table 3 shows the prediction of percentage lean in the beef carcass side. Composition of the loin explains the most variation (CD= 85.6) in carcass lean for steers. In heifers, the rib had the highest CD (91.6 percent) for overall carcass lean. Except for the steer rounds, each of the primals explained at least 82.5 percent of the variation in carcass lean.

Prediction of carcass subcutaneous fat

The round, rib, loin and chuck explained 80.3 percent, 70.5 percent, 89.5 percent and 71.8 percent, respectively, of the variation for subcutaneous fat in the steer population (Table 3). Coefficients of determination for the heifer population ranged from 88.1 to 90.0 percent, with the chuck having the highest relationship to total subcutaneous fat in a carcass.

Prediction of carcass seam fat

The chuck explained the most variation for both steers and heifers, 91.5 versus 93.3 percent, respectively (Table 3). The large proportion of seam fat in the primal chuck compared to other primals probably contributes to the high relationship.

Prediction of carcass bone

Table 3 shows the relationship of primal composition to total bone content in the carcass. In this study, the steer chuck explained 81.6 percent of the variation. For the heifer population, the rib explained the most variation (90.6 percent). Relationships to bone were generally lower than other carcass components.

Each primal cut has a high relationship to overall composition. From this data, the best primal cut to predict composition depends on sex class and which component of composition is of greatest importance. Excluding bone, the loin provided the highest or second highest CD for lean or fat content of steer carcasses compared to other primals. The steer chuck appears more useful than the

(Continued on next page)

Table 4. Prediction of percentage lean, subcutaneous fat, seam fat and bone in the round, rib, loin and chuck of steers

			Regression equation						
Sex class	Primal	Predicted carcass component	Intercept	Yield grade	Primal lean	Primal subcutaneous	Primal seam fat	Primal bone	RMSE[a]
Steers n=53	Round	Lean	.8816	-1.9877	.8336	.2685	.0336	.2975	1.78
		Subcutaneous fat	51.9917	.3039	-.5018	.0202	-.2585	-.5965	1.00
		Seam fat	3.7809	1.1239	.0500	.2961	.5943	-.1259	1.38
		Bone	8.7883	-.3657	-.0138	-.0804	-.0607	.6304	.80
	Rib	Lean	51.6425	-1.5541	.2913	-.3347	-.1619	-.0185	1.64
		Subcutaneous fat	50.6758	.4562	-.5051	-.0431	-.3551	-.5066	1.23
	Seam fat	8.1480	.4288	-.0588	.2582	.3939	.0174	1.13	
		Bone	18.9098	-.0179	-.0359	-.1845	-.1318	.2010	1.10
	Loin	Lean	52.64	-1.3339	.2672	-.3072	-.3662	-.0872	1.42
		Subcutaneous fat	32.3041	.0465	-.3172	.2788	-.2911	-.2402	.75
		Seam fat	34.5775	.6547	-.2803	-.0274	.2248	-.3620	1.00
		Bone	-5.5360	-.2064	.1905	-.0204	.2069	.5140	.84
	Chuck	Lean	40.28	-1.3691	.4757	-.4994	-.2510	-.2336	1.58
		Subcutaneous fat	19.4160	.2617	-.1717	.7606	-.0160	-.2084	1.21
		Seam fat	-7.3973	.1579	.1120	.5907	.7205	.1201	.74
		Bone	35.0262	.2015	-.2505	-.5249	-.3812	.2811	.70

[a]RMSE = Root mean square error.

Table 5. Prediction of percentage lean, subcutaneous fat, seam fat and bone in the round, rib, loin and chuck of heifers.

			Regression equation						
Sex class	Primal	Predicted carcass component	Intercept	Yield grade	Primal lean	Primal subcutaneous	Primal seam fat	Primal bone	RMSE[a]
Heifers n=38	Round	Lean	70.74	-1.4402	.0761	-.6495	-1.0144	-.0861	1.70
		Subcutaneous fat	49.7642	.5636	-.4229	.0159	-.1045	-.8506	1.22
		Seam fat	51.13	.6132	-.4255	-.1134	.5455	-.7330	1.48
		Bone	-20.7482	-.2818	.2533	.1577	.0553	1.1334	.96
	Rib	Lean	36.45	-.3805	.5291	-.2061	-.2376	-.0903	1.56
		Subcutaneous fat	47.4341	.00541	-.4893	.1358	-.2939	-.4402	1.18
		Seam fat	53.0677	-.3950	-.5715	-.1255	.0697	-.2854	1.08
		Bone	-3.3666	.2683	.2023	-.0072	-.0513	.4432	.88
	Loin	Lean	-37.50	-1.6391	1.0822	.7297	.4773	1.1084	2.07
		Subcutaneous fat	46.5016	.1385	-.4263	-.0225	-.2178	-.5419	1.19
		Seam fat	72.1757	.4427	-.6267	-.4682	.0149	-.8439	1.27
		Bone	-21.7126	.1164	.3588	.2300	.0853	.7147	1.03
	Chuck	Lean	24.36	-1.7572	.5623	-.4857	-.0400	.2495	1.57
		Subcutaneous fat	-26.6074	.4765	.2859	1.2058	.5134	.1636	1.12
		Seam fat	63.4228	.5043	-.5950	-.0486	-.0516	-.6369	1.03
		Bone	25.4192	.0290	-.1207	-.4339	-.3443	.3283	1.06

[a]RMSE = Root mean square error.

round or rib, except for seam fat. Less labor would be required to physically separate the loin than the chuck, but the cost of the primal would be greater. For heifers, the chuck (excluding prediction for bone content) and the rib had the highest CD for composition, although all the primals gave high relationships and differences in predictive accuracy may not be meaningful or significant. Ultimately, which primal to physically separate hinges upon resources available and information needed. Prediction equations may provide important information to researchers with neither the time nor the resources to conduct total carcass physical separation (Tables 4, 5).

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