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Variation in and effects of prefabrication fat trimming on yields and prediction equation accuracies of retail product and fat trim

Abstract

Carcass data from one side of 1,149 steers born from 1986 to 1990 were analyzed to develop means for carcass traits and retail product percentage by yield grades. Carcasses from 610 of these steers born from 1988 to 1990 were fabricated to two fat trim levels (.30 and .00 in.), with subcutaneous fat and intermuscular (internal) fat weighed separately. Subcutaneous fat from the primal round, loin, rib, chuck, brisket, and flank in excess of .30 in. plus the kidney knob were considered to constitute an industry "˜hot-fat trim equivalent' (HFTE). Quadratic regression curves were plotted for percent retail product (RP) and percent fat trim (FT) vs. USDA yield grade. In addition, prediction equations were developed for weights and percentages of RP and FT that could be used in plants that do hot-fat trimming and quality grading of carcasses. Percentage of RP, trimmed to either .30 or .00 in. of fat, decreased an average of 4% for each full yield grade increase. Trimming to .00 in. of fat instead of .30 in. reduced RP about 5.5%. The average percentage of HFTE for a yield grade 3.0 carcass was 8.4%. The range in percentage of RP at both trim levels was reduced by trimming fat to an HFTE basis , but considerable range still existed. The range in percentage of internal (seam) fat across yield grades was greater than the range in percentage of HFTE. An equation to predict percentage RP in HFTE carcasses using percentage of hot fat trim, carcass weight, ribeye area, and marbling score had an R2 of .75, which was considerably higher than that for an equation using USDA yield grade traits from untrimmed carcasses (R2=.54). The high accuracy of our prediction equation suggests that the industry could use it to accurately predict closely trimmed RP percentage of hot-fat trimmed carcasses.

Keywords

Cattlemen's Day, 1996; Kansas Agricultural Experiment Station contribution; no. 96-334-S; Report of progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 756; Beef; Carcass; Prefabrication fat trimming; Meat yields

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VARIATION IN AND EFFECTS OF PREFABRICATION FAT TRIMMING ON YIELDS AND PREDICTION EQUATION ACCURACIES OF RETAIL PRODUCT AND FAT TRIM [1]

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Summary

Carcass data from one side of 1,149 steers born from 1986 to 1990 were analyzed to develop means for carcass traits and retail product percentage by yield grades. Carcasses from 610 of these steers born from 1988 to 1990 were fabricated to two fat trim levels (.30 and .00 in.), with subcutaneous fat and intermuscular (internal) fat weighed separately. Subcutaneous fat from the primal round, loin, rib, chuck, brisket, and flank in excess of .30 in. plus the kidney knob were considered to constitute an industry 'hot-fat trim equivalent' (HFTE). Quadratic regression curves were plotted for percent retail product (RP) and percent fat trim (FT) vs. USDA yield grade. In addition, prediction equations were developed for weights and percentages of RP and FT that could be used in plants that do hot-fat trimming and quality grading of carcasses. Percentage of RP, trimmed to either .30 or .00 in. of fat, decreased an average of 4% for each full yield grade increase. Trimming to .00 in. of fat instead of .30 in. reduced RP about 5.5%. The average percentage of HFTE for a yield grade 3.0 carcass was 8.4%. The range in percentage of RP at both trim levels was reduced by trimming fat to an HFTE basis, but considerable range still existed. The range in percentage of internal (seam) fat across yield grades was greater than the range in percentage of HFTE. An equation to predict percentage RP in HFTE carcasses using percentage of hot fat trim, carcass weight, ribeye area, and marbling score had an R^2 of .75, which was considerably higher than that for an equation using USDA yield grade traits from untrimmed carcasses (R^2=.54). The high accuracy of our prediction equation suggests that the industry could use it to accurately predict closely trimmed RP percentage of hot-fat trimmed carcasses.

(Key Words: Carcass, Prefabrication Fat Trimming, Meat Yields.)

Introduction

The three major U.S. beef processors produce 'close-trimmed' (maximum of .25 in. of surface fat) boxed beef. The demand for that product has increased to about 43% of total boxed beef production. In 1989, the USDA/AMS uncoupled yield and quality grading to allow for innovative processing technologies, such as hot-fat trimming (trimming before carcasses are chilled). Although carcasses cannot be yield graded after hot-fat trimming, they can be quality graded. Until recently, one major beef processor was 'hot-fat trimming' much of their production to .25 in. or less. But now, the three major beef processors trim fat after carcass chilling during fabrication.

Several research studies have reported that, as expected, hot-fat trimming reduced the

[1]This article was derived from data from the Germ Plasm Evaluation project that was conducted under the leadership of Dr. Larry Cundiff at the Roman L. Hruska U.S. Meat Animal Research Center, Clay Center, NE. Michael E. Dikeman was a collaborator on the carcass retail product data collection.

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variation in cutability across different cattle types and yield grades, even though only subcutaneous fat is removed. Much of the variation that remains is due to differences in intermuscular fat and has not been well quantified.

Our objectives were to estimate the variability in cutability among carcasses that were trimmed to the equivalent of hot-fat trimmed carcasses; to determine the relative effects of subcutaneous and internal fat on cutability; to examine the regression of fabrication components on yield grade; and to develop prediction equations for carcass composition that use 'hot fat trim equivalent' and available cooler measurements.

Experimental Procedures

Carcasses from 1149 steers from Cycle IV of the Germ Plasm Evaluation research program at the U.S. Meat Animal Research Center were used. Eleven sire breeds were mated to Hereford and Angus dams to produce F_1 progeny in five calf crops (1986- 1990). Calving occurred from late March through mid-May, and after a postweaning adjustment of about 35 days, steers were fed a growing diet until they reached about 700 lb live weight. Steers then were fed a high concentrate diet until slaughtered serially in four groups about 3 weeks apart in a commercial processing plant. After a 24-hr chill, USDA yield grade and quality grade data were obtained. Right sides from all five calf crops were fabricated into retail product (RP) (roast and steak meat trimmed to .30 in. of subcutaneous and internal fat at all surface locations, plus lean trim with 20% fat). After all components were weighed and recorded, all subcutaneous and accessible internal fat was removed (.00 in.) from roast and steak meat, then reweighed.

For the 610 sides from cattle born in 1988 to 1990, the round, loin, rib, chuck, brisket, and flank were trimmed to .30 in. of subcutaneous fat cover (includes cod fat from the flank). In our study, the weight of the side after trimming the primal cuts to .30 in. of subcutaneous fat, plus additional subcutaneous fat in excess of .30 in. trimmed during fabrication of the subprimals, plus the kidney and pelvic fat were considered to constitute an industry 'hot-fat trim equivalent' (HFTE).

Equations were developed to predict percentages of retail product (RP) and fat trim using traits obtainable in plants that do hot-fat trimming and quality grading of carcasses.

Results and Discussion

Table 1 presents the distribution of carcasses and means for carcass traits in the different yield grades for all 1,149 steers (1986-90) and for the 610 steers born in 1988-90. As expected, hot carcass weights, adjusted fat thicknesses and percentages of kidney and pelvic fat increased as yield grade number increased. Longissimus muscle area decreased as yield grade number increased to 3.2, then did not change consistently as yield grade increased to 5.5. Marbling score and percentage of carcasses grading Choice increased up to yield grade 3.7 and then did not increase further. Percentage of RP, when trimmed to either .30 in. (RP .30) or .00 in. (RP .00) of surface fat decreased by an average of 4% for each full yield-grade increase. Trimming to .00 in. vs. .30 in. resulted in about 5.5% less RP.

For the 610 carcasses from cattle born from 1988 to 1990, when carcasses were trimmed to an HFTE basis, the percentage of fat removed increased nearly linearly through the full range of yield grades (Figure 1). The average percentage of HFTE for yield grade 3.0 carcasses was about 8.4%.

Figure 2 illustrates how percentage of RP .00 changed as yield grade increased. Even though percentage of RP .00 decreased more rapidly on an untrimmed carcass basis than on an HFTE carcass basis, it still decreased about 12 percentage points across the range of yield grades. Figure 2 clearly shows that a considerable range occurs in percentage of RP among carcasses, even after HFTE, and suggests that some method is needed to predict yields of carcasses after hot fat trimming.

Figure 3 illustrates how subcutaneous fat trim (.00 in.) increased for untrimmed carcasses and carcasses after HFTE (.30 in.) as yield grade increased. The rate of increase in fat trim was faster on a carcass basis after HFTE than on an untrimmed carcass basis. This suggests that an increasing proportion of subcutaneous fat may be left on carcasses during hot fat trimming as yield grade increases. The predicted percentage of subcutaneous fat trim (.00 in.) (excluding kidney knob) on an untrimmed carcass weight basis for yield grade 3.0 carcass was 7.2%.

Figure 4 illustrates how internal (seam) fat increased as yield grade increased. A wider range occurred in internal fat trim than in percentage of HFTE (Figure 1).

Use of HFTE clearly reduces the range in percentage yields of RP and FT; however, considerable difference still exists. Thus, methods are needed to predict yields of hot-fat trimmed carcasses, so we developed prediction equations using traits available in plants that do hot fat trimming and quality grading of carcasses.

Prediction equations that we developed for weights and percentages of carcass components and their R^2 values are shown in Table 2. Weight of RP was predicted with a high degree of accuracy (R^2=.93) using weight of HFTE, carcass weight after HFTE, ribeye area, and marbling score. Predicting the weight of FT remaining after HFTE was somewhat less accurate (R^2 = .80). Percentage of RP could be predicted with more accuracy than percentage of fat trim remaining after HFTE (R^2=.75 vs .62).

Comparing R^2 values in Tables 2 and 3 shows that equations using HFTE for predicting percentages of RP and FT were consistently more accurate than those using USDA yield-grade traits.

Table 1. Distribution of Carcasses and Means for Carcass Traits in Yield-Grade Categories for All Steers Born 1986-90 and Distribution and Mean Yield Grades for Steers Born 1988-90

	Yield Grade Category							
Variable	<2.0	2.0-2.49	2.5-2.99	3.0-3.49	3.5-3.99	4.0-4.49	4.5-4.99	≥5.0
1986-90								
No. carcasses	70	143	262	265	208	118	48	36
Hot carcass wt, lb	643.6^a	661.7^{ab}	672.7^b	705.4^c	751.5^d	767.3^d	801.7^e	835.3^e
Adj. fat thickness, in.	.21^a	.27^b	.34^c	.43^d	.54^e	.67^f	.85^g	1.04^h
Longissimus muscle area, $in.^2$	13.2^a	12.3^b	11.6^c	11.3^{de}	11.5^{cd}	11.2^{ef}	11.4^{cde}	10.7^f
Kidney and pelvic fat, %	2.3^a	2.5^b	2.7^c	2.9^d	3.1^e	3.2^f	3.5^g	3.6^g
Yield grade	1.7^a	2.3^b	2.7^c	3.2^d	3.7^e	4.2^f	4.7^g	5.5^h
Marbling score[i]	4.5^a	4.8^b	5.0^c	5.2^d	5.4^e	5.5^e	5.6^e	5.5^e
Percentage ≥ Choice	20.0^a	39.0^b	53.4^c	66.3^d	76.1^e	83.5^e	81.3^e	80.6^e
Retail product at .30 in.								
Retail product at .00 in.								
1988-90								
No. carcasses	23	57	139	141	121	66	33	30
Yield grade	1.8^a	2.3^b	2.8^c	3.2^d	3.7^e	4.2^f	4.8^g	5.6^h

[a,b,c,d,e,f,g,h] Means in the same row without a common superscript letter differ ($P < .05$).
[i] 4.00-4.90 = slight; 5.00-5.90 = small, etc.

Table 2. Regression Equations and Residual Standard Deviations (RSD) for Predicting Weights and Percentages of Retail Product and Fat Trim at .00 in. Fat Trim Using Data from Hot Fat Trimmed Equivalent Carcasses

		Parameter Estimates					
Equation for	Intercept	Carcass Wt., lb	Hot Fat Trim, lb	Ribeye Area, in.^{2}	Marbling Score[a]	R^2	RSD
lb Retail product	22.95	.72	-1.55	3.84	-8.20	.93	6.39
lb Fat trim	-44.61	.12	.77	-1.138	5.60	.80	5.15
% Retail product	78.95	-.005	-1.56	.516	-1.14	.75	1.95
% Fat trim[b]	-.085	.006	.98	-.129	.82	.62	1.68

[a]4.00 - 4.90 = slight; 5.00 - 5.90 = small, etc.
[b]Dependent variable is percentage of fat trim after hot-fat trim equivalent.

Table 3. Regression Equations and Residual Standard Deviations for Predicting Weights and Percentages of Retail Product and Fat Trim at .00 in. Fat Trim from Traits Used in Determining USDA Yield Grades

		Parameter Estimates					
Equation for	Intercept	Adjusted Fat Thickness, in.	Kidney and Pelvic Fat, %	Ribeye Area, in.^{2}	Hot Carcass Wt.,lb	R^2	RSD
lb Retail product	23.20	-72.97	-8.91	8.96	.52	.86	8.58
lb Fat trim	-63.46	83.95	10.12	-6.68	.33	.83	7.62
% Retail product	65.69	-9.93	-1.29	1.23	-.013	.54	2.66
% Fat trim	13.64	11.38	1.48	-.84	.014	.64	2.38

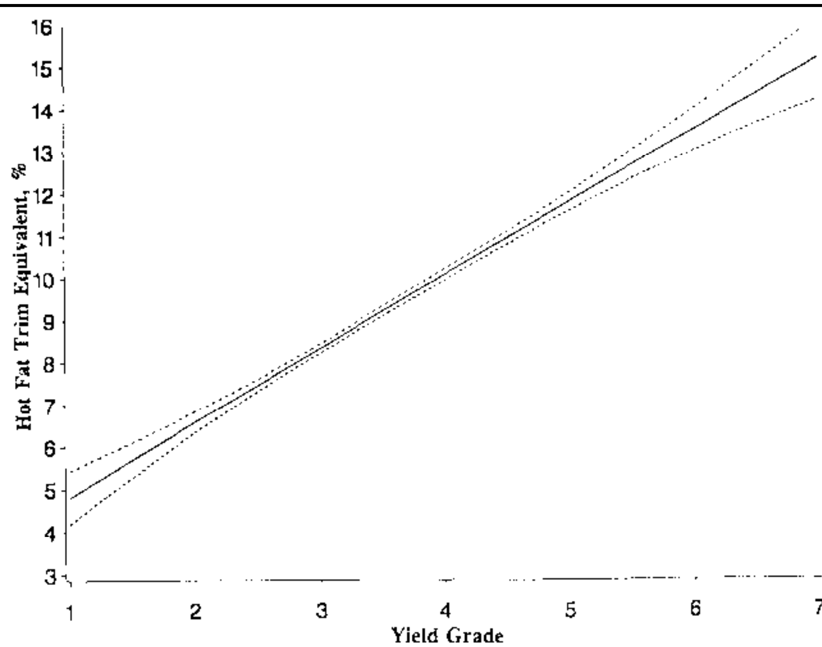

Figure 1. Hot-Fat Trim Equivalent as a Percentage of Carcass Weight as Yield Grade Increases

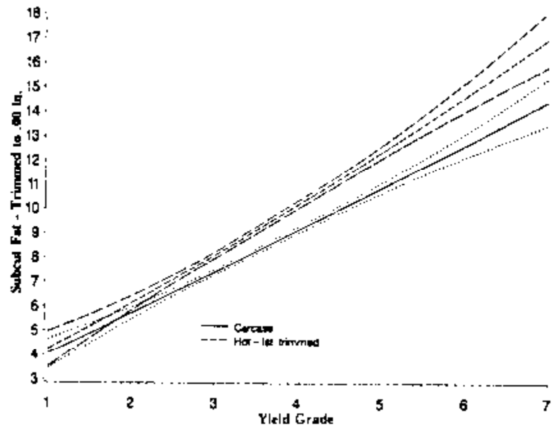

Figure 2. **Retail Product Trimmed to .00 in. Fat Cover as a Percentage of Carcass Weight and as a Percentage of Hot-Fat Trim Equivalent Carcass Weight Relative to Yield Grade Increases**

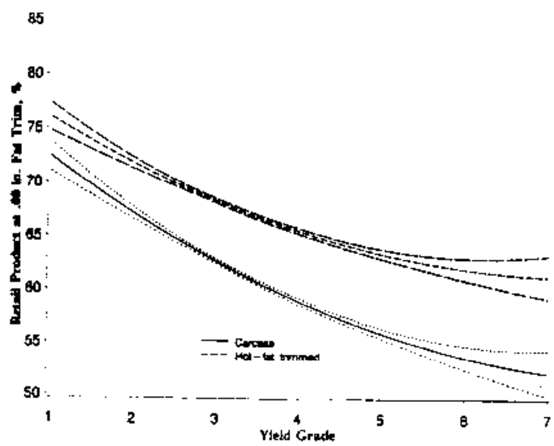

Figure 3. **Subcutaneous Fat Trimmed to .00 in. as a Percentage of Carcass Weight and as a Percentage of Hot-Fat Trim Equivalent Carcass Weight Relative to Yield Grade Increases**

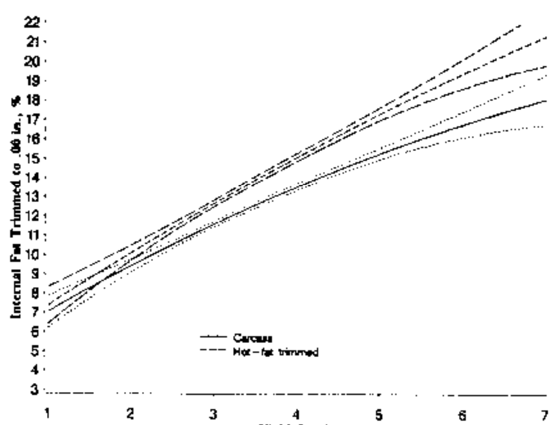

Figure 4. **Internal Fat Trimmed to .00 in. as a Percentage of Carcass Weight and as a Percentage of Hot-Fat Trim Equivalent Carcass Weight Relative to Yield Grade Increases**