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Sorting beef subprimals by loin muscle area to maximize utility and product uniformity of portioned steaks for the foodservice and retail sectors (#549)

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Introduction

At the processor level, some beef subprimals are sorted by weight during boxing into "lights" and "heavies" based on the box containing products above or below a set weight threshold. Sorting subprimals by weight does little to provide foodservice operators and retailers with uniform products because of the size variability of products that remains within and between boxes. Improving the consistency and uniformity of beef subprimals purchased by these segments of the industry may lead to more appropriate utilization so that steaks portioned by either thickness or weight meet or exceed customer expectations for a desirable eating experience.

In the U.S., all major beef packers have instrument-grading technology to efficiently and effectively measure carcass characteristics including loin muscle area (LM area). Existing instrument technology could be utilized to segment carcasses based on LM area rather than sorting individual subprimals by weight. This study sorted beef carcass sides into five LM area categories before the carcass sides were fabricated into ribeyes, strip loins, and tenderloins for further analysis.

Methods

Instrument grading technology was used to select 100 USDA Choice, yield grade 2 or 3 sides, and 100 USDA Select, yield grade 2 or 3 sides. Carcass sides were sorted into one of five loin muscle area (LM area) categories based on measuring the *M. longissimus thoracis* at the 12th rib, as outlined in Table 1. Table 1. Loin muscle area (LM area) categories and associated LM area ranges

LM Area Category	LM area (cm^2)	Allowable range (cm^2)
1	77.4	74.8 to 80.6
2	83.9	81.3 to 87.1
3	90.3	87.7 to 93.5
4	96.8	94.2 to 100.0
5	103.2	100.6 to 106.4

USDA Choice carcass sides were fabricated to remove beef rib, ribeye, lip-on (IMPS 112A) and beef loin, strip loin, boneless (IMPS 180) subprimals. Beef loin, tenderloin, full, side muscle on, partially defatted (IMPS 189B) subprimals were removed from each USDA Select side. Subprimals were weighed, trimmed to specification, and passed through a 3-D visual analysis machine to obtain scan data for a variety of portioning outcomes generated by simulation software, either by steak thickness or by weight.

Data were analyzed by (1) portion weight by LM area category and (2) portion thickness by LM area category using JMP Pro software (version 14.0, SAS Institute Inc., Cary, NC). Qualitative assessments were made of the appropriateness of each portion and method within and across the LM area categories. The Fit Y by X function was used for ANOVA, and least squares means comparisons were conducted using Tukey-Kramer HSD. Correlations were determined using the multivariate functions. Mean values were determined using the distribution function.

Results

Target optimal thickness for ribeye and strip loin steaks was identified as 31.8 mm (1.25 in). After evaluation of multiple portioning outcomes, it was determined that a 396.89 g (14-ounce) portion, for each LM area category, most consistently delivered the preferred steak thickness. LM area categories 1 and 2 most frequently produced desirable thickness and portion weight outcomes in ribeye and strip loin steaks. Statistical analysis of number of portions per subprimal stratified by portion weight and portion thickness revealed differences ($P < 0.05$) across all LM area categories in both ribeyes and strip loins. As portion weight and thickness increased, steak portion number tended to decrease.

In tenderloins, an optimal steak thickness of 44.5 to 50.8 mm (1.75 to 2.00 in) was identified. Most frequently, 226.80, 255.15, and 283.50 g (8, 9, and 10-ounce) portions met the targets for optimal portion weight and thickness parameters. For tenderloins, number of portions by portion weight showed significant differences ($P < 0.05$) in all LM area categories with the exception of 198.45 g (7-ounces), and showed no statistical differences when stratified by portion thickness. In this investigation, USDA Choice carcasses ($r = 0.76$) and USDA Select carcasses ($r = 0.56$) expressed moderate correlation between LM area and hot (unchilled) carcass weight.

Based on historical and current sorting methods of subprimals at boxing, weight break thresholds were established: ribeyes at 7.71 kg (17 lbs), strip loins at 6.80 kg (15 lbs), and tenderloins at 3.18 kg (7 lbs). Figure 1 shows percentage of subprimals below the established weight thresholds with each LM area category. As LM area increased, the percentage of subprimals weighing below the weight threshold tended to decrease. As subprimal

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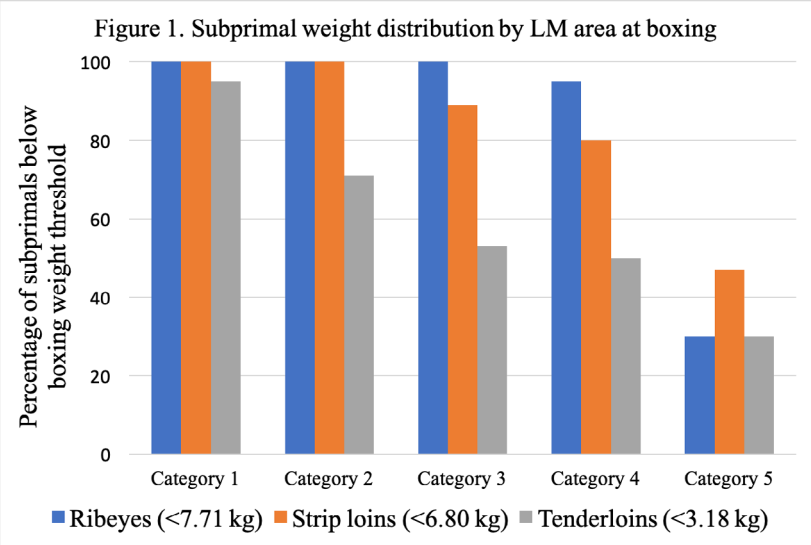
weight increased, so did average LM area size, but the variation within box ranged widely by as much as 30.97 cm^2 in ribeyes, 29.03 cm^2 in strip loins and 30.9 cm^2 in tenderloins. These data suggest sorting by LM area size may be preferable to sorting by subprimal weight at boxing.

Conclusion

Strip loin, ribeye, and tenderloin subprimals from carcasses in LM area categories 1 and 2 (74.8 cm^2 to 87.1 cm^2) provided the most flexible portioning options for use in foodservice and retail sectors. These results suggest there is potential for improving consistency and utility of subprimals destined for foodservice and retail sectors by sorting carcasses by LM area rather than by weight.



Subprimal weight distribution by LM area at boxing

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