Quality Impacts When Changing the Forequarter Break Point

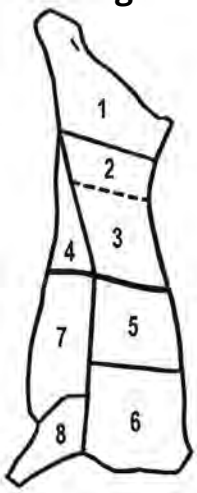
C.R. Calkins, University of Nebraska-Lincoln

In 1925, William Tomhave, Head of the Animal Husbandry Department at Pennsylvania State College, described the commercial method of cutting beef as being "very desirable, both from an economical and a practical point of view."

Practical – and therefore easy – was the apparent criterion for a number of the break points between wholesale cuts. For example, separating the forequarter from the hindquarter between the 12th and 13th ribs was "for the purpose of holding the loin shape while being cut into steaks." Anyone who has cut chilled, post-rigor beef loins might not find this to be a compelling argument. The convenience of having a rib on which to catch the hook from a meat tree when hanging a loin primal might have been a better reason to leave the last rib in the hindquarter. Of course, leaving extra ribs on the hindquarter also increased the weight of the more valuable quarter. In the 1920's it was popular for carcasses quartered in Boston to have up to 3 ribs left on the hindquarter. Conversely, Philadelphia was known to leave all of the ribs in the forequarter.

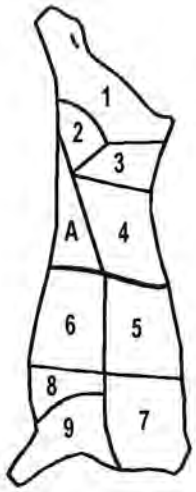
It's tempting to speculate that the 12th/13th rib break was established because that's where we grade the carcass. However, the USDA grades for carcass beef did not specify this cutting location until 1965, long after this convention was adopted by the industry.

Chicago



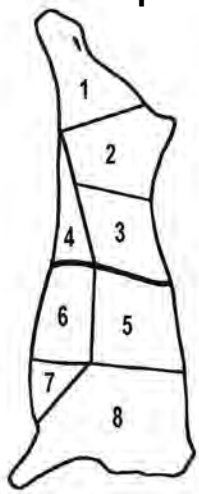
1	Round	24%
2	Loin End	9%
3	Short Loin	8%
4	Flank	4%
	(suet)	4%
	Hindquarter Total	49%
5	Rib (7 ribs)	9%
6	Chuck (5 ribs)	26%
7	Plate	12%
8	Shank	4%
	Forequarter Total	51%
	Side of Beef Total	100%
	12 Ribs on Forequarter	

New York



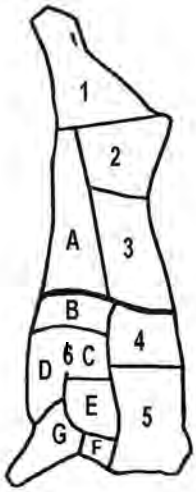
1	Round (with Flank A)	24%
2	Top Sirloin (or Butt)	6%
3	Short Hip	6%
	(N.Y. Full Hip 2 & 3)	
4	Short Loin (incl. suet)	12%
	Hindquarter Total	48%
5	Rib (8 ribs)	10%
6	Plate	10%
7	Short Chuck (4 ribs)	16%
	(N.Y. Full Chuck 7-8-9)	
8	Brisket	8%
9	Shoulder	8%
	Forequarter Total	52%
	Side of Beef Total	100%
	12 Ribs on Forequarter	

Philadelphia



1	Round	18%
2	Rump	12%
3	Loin (incl. suet)	12%
4	Flank	4%
	Hindquarter Total	46%
5	Rib (8 ribs)	10%
6	Plate	10%
7	Butt	4%
8	Chuck (5 ribs)	30%
	Forequarter Total	54%
	Side of Beef Total	100%
	13 Ribs on Forequarter	

Boston



1	Round (with flank "A")	23%
2	Rump	11%
3	Loin (3 ribs)	15%
	Cod Fat	2%
	Hindquarter Total	51%
4	Rib (5 ribs)	6%
5	Chuck (5 ribs)	18%
6	Rattle includes	25%
	Navel B	
	Middle Rib C	
	Brisket D	
	Shoulder E	
	Sticker F	
	Shin G	
	Forequarter Total	49%
	Side of Beef Total	100%
	10 Ribs on Forequarter	

Figure 1. Regional break points (Adapted from Rhodes, E.L. 1929).

Other break points for carcass fabrication also showed regional variation (**Figure 1**). Rhodes (1929) reported that primal ribs ranged from 5-8 ribs and chucks had 4-5 ribs, compared to the 7-rib ribs and 5-rib chucks marketed today. Many of these break points were likely established for convenience. When cutting a beef carcass with a hand saw and a knife, it makes sense to minimize the bones through which one would have to saw. Thus, a 5th/6th rib break is more "user friendly" than a 2nd/3rd rib break because no saw is needed to cut through the scapula in the 5th/6th rib location.

An important step for standardized beef fabrication occurred when President Franklin Roosevelt's Office of Price Administration – citing the Emergency Price Control Act of 1942 and Executive Order No. 9250 issued by the President on Oct. 3, 1942 – fixed maximum wholesale prices for beef and veal during the Second World War (Revised Maximum Price Regulation No. 169 Beef and Veal Carcasses – Wholesale Cuts, Dec. 10, 1942). In order to limit the wholesale prices for cuts, consistent definitions for cuts were required. Consequently, any beef sold in the U.S. had to be fabricated by a defined method, which included a 12th/13th rib break for the quarters and a 5th/6th for the rib-chuck break. In addition, all carcasses had to be graded – although the names of grades were changed to letters (AA, A, B, and C). These mandates were in place during the war and were released in 1946. For four years, then, all beef was cut in a standardized manner. Afterward, individual cutting methods were still in use but the main break points and cut definitions had been set.

While the cuts were standardized, there was precious little science used to define any of the break points. Intuition, ease of application, convenience – these are the reasons one finds for the existence of the current break points. Moreover, carcass break points fluctuate in markets around the world with numerous examples of different rib breaks in beef-producing countries around the world like those in Europe and Asia.

Given the success of the beef checkoff's muscle profiling research, the opportunity exists to re-examine the appropriate place to portion muscles into cuts. Decisions based on quality, rather than convenience, should help to optimize carcass value.

In 2002, Reuter et al. (J. Anim. Sci. 80:101-107) published a paper exploring the point of separation during carcass fabrication, between the wholesale rib and the wholesale chuck. They showed that tenderness on the chuck side of the break was equal to the rib side, and suggested a possible 4th/5th rib break. Steaks from the posterior end of the chuck roll are often merchandized as Delmonico or Chuck Eye Steaks. It is attractive from a value standpoint to have steaks with comparable tenderness segregated with a single subprimal.

Subsequent research conducted at the University of Nebraska (Hosch et al., 2013 Nebraska Beef Cattle Report, P. 100-101) reinforced that tenderness similarities exist on either side of the 5th/6th rib break for the rib and chuck. The objectives of this research was to evaluate quality-based break points during fabrication versus tradition-based breaks and add value to beef carcasses by optimizing use of high-quality muscles like those in the chuck/rib juncture.

Since current beef carcass breaks are based on historical and/or traditional practices, they are not always relevant to product eating qualities and carcass value. Specifically for the rib/chuck separation, which is currently between the 5th and 6th ribs of the carcass, the potential for maintaining eating qualities and improving cutout value by separating the rib/chuck between the 4th and 5th ribs exists. Reuter et al. (2002) stated that "Based on analyses of shear force and consideration of consumer purchase preference information, there seems to be no logical reason for separating the beef wholesale rib from the beef wholesale chuck between the 5th and 6th ribs other than tradition." Reuter et al. (2002) also suggested that separating the rib and chuck between the 4th and 5th ribs was a viable option as it would have minimal effect on beef consumer satisfaction.

Exploring different forequarter break points is a complex initiative. A modest shift in the rib/chuck break, for example, could impact the wholesale rib, the chuck roll, back ribs, rib lifter meat, the top blade, and the short rib complex. Depending on the location of the break, significant changes in fabrication operations might be needed.

Recent Research

In examining an industry carcass break change, more information was needed to explore if leaving the extra chuck on the rib primal would sacrifice eating characteristics associated with the current rib primal. Information was also needed on anticipated yield impacts of a carcass break change.

Characterizing Products from the Beef Rib Resulting from an Alternative Carcass Break

T.P. Manchilha, D.R. Woerner, J.N. Martin, R.J. Delmore and K.E. Belk, Colorado State University

This study sought to show how size, shape, and eating characteristics of the muscles involved would change with a move in the forequarter break. Specifically, the objectives of the study were to evaluate the effects of breaking the beef rib from the beef chuck between the 4th and 5th ribs versus the 5th and 6th ribs on product tenderness, product yields and product conformation.

Thirty carcasses with the same USDA low Choice quality grade were selected from a commercial packing facility. Alternating sides from each carcass were fabricated into either an 8-rib rib separated from the chuck between the 4th and 5th ribs or a traditional 7-rib rib separated from the chuck between the 5th and 6th ribs. As a result, all comparisons between 8-rib and 7-rib ribs were made within animal. Individual identification was maintained for each rib, and traditional carcass data measurements were collected from each carcass. Concurrent to the fabrication procedures, weights for each product were collected and comprehensive, sequential yield data were obtained.

Within 7 days of product collection, the ribeye rolls were taken to a steak portioning facility and all were cut into equally portioned Ribeye Steaks. At the time of portioning, steak weights, steak thicknesses, steak number/count, and trim weights were collected and recorded, and an image of each steak was obtained. All meaningful dimensional measurements including total portion area, maximum length, maximum width, individual muscle areas, individual muscle lengths, individual muscle widths, fat areas, tail lengths, total area of lean, and total area of fat were measured and recorded for each image. Following image capture, steaks were individually identified, packaged, frozen and stored for shear force evaluations.

Warner-Bratzler Shear Force (WBSF) values were obtained for the primary muscles in every steak resulting from all 30, 8-rib ribs. A mean WBSF value was obtained and averaged for each muscle individually. Thawed steaks were cooked to a peak internal temperature of 71°C. The internal temperature of steaks was monitored with a thermocouple during cooking, and steaks were removed from the oven in order to achieve the desired peak internal temperature. Each steak was allowed to equilibrate to room temperature and a maximum number of cores for each muscle were removed. Each core was sheared once, perpendicular to the muscle fibers.

Comparisons of least squares means was computed for all measurements by treatment (8-rib vs. 7-rib) and for individual steak by steak location. The interaction of treatment and steak location was tested for individual steak measurements. Peak shear force of each core was recorded, and the resulting values were averaged to obtain a single WBSF value for each muscle within each steak.

The new fabrication style increased the length of the rib by 2 inches per side, which resulted in 2.8 more steaks per carcass, on average.

Longissimus dorsi WBSF values were different by steak location. Conversely, *Complexus* and *Spinalis dorsi* WBSF values did not differ between steak locations. Although *Longissimus dorsi* WBSF values differed by steak location, there were no meaningful trends identified, which indicates that tenderness was not affected by fabrication style. Furthermore, regardless of muscle size and portion at any given steak location, the WBSF values were similar for all muscles within each steak.

Quality of the beef rib was not found to be reduced due to changing the beef forequarter break from the 5th and 6th rib separation to the 4th and 5th rib separation. These data suggest that if the carcass forequarter break were to change, only piece weights and Ribeye Steaks per subprimal will be influenced and Ribeye Steaks will continue to deliver a consistent eating experience for consumers regardless of where the chuck is split from the rib.

Beef Rib Alternative Industry Cutting Trial

K. R. McCullough, D. R. Woerner, J. N. Martin, J.D. Tatum, R. J. Delmore and K. E. Belk, Colorado State University

This research was conducted to further investigate the option to separate the rib and chuck between the 4th and 5th ribs with the acceptance of the United States Department of Agriculture (USDA) for labeling and marketing purposes. As earlier research has confirmed this is a viable opportunity, industry packer partners and USDA-Agricultural Marketing Service (AMS) expressed the need to conduct a cutting trial in a commercial plant setting, in order to further demonstrate product yield and value differences. Therefore, this checkoff study was conducted to determine yield differences between the traditional, 5th and 6th chuck/rib separation and the 4th and 5th chuck/rib separation.

To determine yield and value differences, paired forequarters were fabricated in a commercial processing facility. Both sides were fabricated according to the standard company cutout strategies, with the only difference between sides being the location of the chuck and rib separation (5th and 6th chuck-rib separation versus 4th and 5th chuck-rib separation). All saleable product weights, including saleable cuts, bone, fat, and trimmings, were collected and analyzed. Additionally, finished cuts and trim pieces were run though a Foss MeatMaster™ (Denmark) to determine total fat content for each individual piece. **Table 1** shows the difference in weight and value between rib breaks; whereas, **Table 2** presents differences in fat content. Prior to statistical analyses, numerous pieces and trimmings were grouped together to represent specific trim groups based off targeted lean points.

Fabricating carcasses with the alternative break increased (P < 0.05) the weight of the rib and short plate subprimals, as well as, the weight of the ribeye roll and short rib. Furthermore, the ribeye roll had the greatest increase in value of all cuts as a result of the alternative rib break. Breaking carcasses

Table 1. Change in weight and value of cuts fabricated with an alternative rib break (4th/5th rib) compared to cuts fabricated with a traditional rib break (5th/6th rib).

Cut	Change in Weight[1], lb	Change in Value[2], $	P–Value[3]	SEM[4]
Chuck, Initial	-4.480		0.059	1.639
Arm, Initial	-2.543		0.028	0.796
Chuck Roll	-2.394	-7.076	0.007	0.603
Mock Tender	-0.029	-0.066	0.794	0.079
Clod, Initial	-2.582		0.003	0.594
Clod Heart	-0.047	-0.157	0.892	0.245
Teres Major	-0.083	-0.287	0.078	0.032
Top Blade	-0.593	-1.659	0.002	0.136
Chuck Short Rib	-0.893	2.794	< 0.001	0.113
Chuck 93/7 Trim	-1.331	-2.867	< 0.001	0.243
Chuck 85/15 Trim	0.141	0.258	0.574	0.176
Chuck 81/19 Trim	-1.033	-1.652	0.419	0.897
Chuck 73/27 Trim	-0.315	-0.439	0.054	0.113
Chuck 50/50 Trim	-0.742	-0.466	< 0.001	0.074
Chuck XF Trim	-0.555	-0.173	0.401	0.463
Chuck Bone	-1.633	-0.003	0.016	0.463
Brisket, Initial	-0.904		0.359	0.690
Brisket, Finished	-0.840	-1.715	0.279	0.543
Brisket 73/27 Trim	-0.334	-0.466	< 0.001	0.044
Brisket 50/50 Trim	-0.094	-0.059	0.048	0.032
Brisket XF	-0.344	-0.107	0.211	0.192
Brisket Bone	-0.668	-0.001	< 0.001	0.117
Short Plate, Initial	4.464		< 0.001	0.734
Short Plate, Finished	0.488	2.059	0.073	0.188
Short Plate 73/27 Trim	1.878	2.620	0.001	0.395
Short Plate 50/50 Trim	-0.062	-0.038	0.571	0.076
Short Plate XF	0.374	0.116	0.175	0.192
Short Plate Bone	1.516	0.003	< 0.001	0.151
Rib, Initial	5.526		< 0.001	0.728
Ribeye Roll	1.672	10.549	0.007	0.423
Short Rib	0.728	3.072	< 0.001	0.110
Rib 93/7 Trim	1.034	2.227	< 0.001	0.202
Rib 73/27 Trim	0.330	0.460	0.015	0.093
Rib 50/50 Trim	2.454	1.542	< 0.001	0.374
Rib XF Trim	1.052	0.328	0.011	0.284
Rib Bone	1.874	-0.004	< 0.001	0.257

[1]Change in Weight, lb = weight of alternative rib break – weight of traditional rib break

[2]Change in Value = change in weight (lb) x price ($) per lb

[3]Significance for Change in Weight, lb was determined at P < 0.05

[4]Standard error of least squares mean

Table 2. Change in percent fat of cuts fabricated with an alternative rib break (4th/5th rib) compared to cuts fabricated with a traditional rib break (5th/6th rib).

Cut	Change in Fat[1], %	P–Value[2]	SEM[3]
Chuck Roll	-0.580	0.493	0.593
Clod Heart	0.232	0.703	0.428
Mock Tender	-0.254	0.642	0.389
Teres Major	-0.344	0.707	0.643
Top Blade	-1.156	0.092	0.476
Chuck Short Rib	-1.256	0.335	0.912
Chuck 93/7 Trim	0.000	0.999	0.301
Chuck 85/15 Trim	0.848	0.253	0.518
Chuck 81/19 Trim	-0.133	0.843	0.474
Chuck 73/27 Trim	-1.986	0.224	1.142
Chuck 50/50 Trim	-5.830	0.008	1.493
Chuck XF Trim	-1.296	0.096	0.540
Brisket, Finished	0.620	0.520	0.676
Brisket 73/27 Trim	1.150	0.488	1.165
Brisket 50/50 Trim	0.249	0.898	1.380
Brisket XF Trim	-1.711	0.075	0.666
Short Plate, Finished	-0.860	0.469	0.834
Short Plate 73/27 Trim	2.086	0.075	0.810
Short Plate 50/50 Trim	-21.052	< 0.001	2.795
Short Plate XF	-2.708	0.085	1.099
Ribeye Roll	-0.748	0.571	0.927
Short Rib	-2.518	0.857	0.041
Rib 93/7 Trim	-0.229	0.657	0.363
Rib 73/27 Trim	-0.602	0.641	0.908
Rib 50/50 Trim	-3.598	0.009	0.937
Rib XF Trim	-1.328	0.064	0.866

[1]Change in Fat = % fat of alternative rib break – % fat of traditional rib break

[2]Significance was determined at $P < 0.05$

[3]Standard error of the least squares mean

between the 4th and 5th rib did decrease ($P < 0.05$) the weight of several cuts from the arm, chuck, and brisket; however, the reduction in value was not large enough to overcome the advantages in added value to the rib. Generally, no change ($P > 0.05$) was found in the percent of fat of cuts from carcasses fabricated with the alternative rib break. However, percent fat was reduced ($P < 0.05$) in chuck 50/50 trim, short plate 50/50 trim, and rib 50/50 trim.

Switching to the alternative rib break brings substantial more weight and value to the rib, mainly the finished ribeye roll. Although, the alternative rib break reduces weight and value from the chuck, the added weight and value to the rib is greater than the reduced weight and value from the chuck.

Conclusion

The data collected through these studies illustrate the impact on the weight, value and quality of the resulting cuts when comparing a 5th/6th chuck/rib separation to a 4th/5th chuck/rib separation. These data can help inform an industry decision to make changes to the definition of the beef rib and allow for a change in fabrication procedures at the rib/chuck juncture. Additionally, companies may apply this knowledge to their specific systems and make informed decisions regarding the effects of such a change within their carcass fabrication protocols.

References:

Hosch, Justine J., Kim A. Varnold, Lasika S. Senaratne-Lenagala, Michelle E. Semler, Michael D. Chao, and Chris R. Calkins. 2013. Development of 2-Rib and 3-Rib Beef Chuck Subprimal. 2013 Nebraska Beef Cattle Report. University of Nebraska-Lincoln. P. 100-101. Available at http://beef.unl.edu/nebeefreport2013.

Reuter, B. J., D. M. Wulf, B. C. Shanks and R. J. Maddock. 2002. Evaluating the point of separation, during carcass fabrication, between the beef wholesale rib and the beef wholesale chuck. J. Anim. Sci. 80: 1: 101-107.

Rhodes, E.L. 1929. Merchandising Packinghouse Products. The University of Chicago Press, Chicago, IL.

Tomhave, W.H. 1925. In: K.C. Davis, editor. Meats and Meat Products. Lippincott's Farm Manuals, Philladelphia, PA.

For more information, contact:

National Cattlemen's Beef Association
Contractor to the Beef Checkoff Program
9110 East Nichols Avenue
Centennial, CO 80112
303.694.0305