

Foodservice yield and fabrication times for beef as influenced by purchasing options and merchandising styles¹

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ABSTRACT: Selected beef subprimals were obtained from fabrication lines of three foodservice purveyors to assist in the development of a software support program for the beef foodservice industry. Subprimals were fabricated into bone-in or boneless foodservice ready-to-cook portion-sized cuts and associated components by professional meat cutters. Each subprimal was cut to generate mean foodservice cutting yields and labor requirements, which were calculated from observed weights (kilograms) and processing times (seconds). Once fabrication was completed, data were analyzed to determine means and standard errors of percentage yields and processing times for each subprimal. Subprimals cut to only one end point were evaluated for mean foodservice yields and processing times, but no comparisons were made within subprimal. However, those traditionally cut into various end points were additionally compared by cutting style. Subprimals cut by a single cutting style included rib, roast-ready; ribeye roll, lip-on, bone-in; brisket, deckle-off, boneless; top (inside)

round; and bottom sirloin butt, flap, boneless. Subprimals cut into multiple end points or styles included ribeye, lip-on; top sirloin, cap; tenderloin butt, defatted; shortloin, short-cut; strip loin, boneless; top sirloin butt, boneless; and tenderloin, full, side muscle on, defatted. Mean yields of portion cuts, and mean fabrication times required to manufacture these cuts differed ($P < 0.05$) by cutting specification of the final product. In general, as the target portion size of fabricated steaks decreased, the mean number of steaks derived from any given subprimal cut increased, causing total foodservice yield to decrease and total processing time to increase. Therefore, an inverse relationship tended to exist between processing times and foodservice yields. With a method of accurately evaluating various beef purchase options, such as traditional commodity subprimals, closely trimmed subprimals, and pre-cut portion steaks in terms of yield and labor cost, foodservice operators will be better equipped to decide what option is more viable for their operation.

Key Words: Beef, Marketing, Time Allocation, Yields

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Introduction

Retail use of closely trimmed beef subprimals increased during the 1990s (Savell et al., 1995), which was accomplished, in part, by the availability of comparative cutting test information (Garrett et al., 1991). This information (Garrett et al., 1991) was specifically designed to provide accurate, unbiased cutting yields and labor times concerning closely trimmed beef to the retail industry. Data were integrated into a computer software program—Beef CARDS (Computer-Assisted Retail Decision Support)—to assist retailers in making informed purchasing and merchandising decisions. Following positive retailer response to Beef CARDS, Pork, Lamb, and Veal CARDS were developed (Lorenzen et al., 1996a,b; 1997; McNeill et al., 1998).

To date, the CARDS program has been used primarily by the retail sector. Now demand exists to generate similar information suited to the foodservice industry.

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This study was conducted to determine cutting yields and time requirements for beef subprimals as they were portioned to form ready-to-cook foodservice cuts.

Materials and Methods

Product Selection

Two hundred forty-one randomly selected bone-in and boneless beef subprimals were obtained from the fabrication lines of three foodservice purveyors. Selected subprimals represented a variation in weight and fat thickness and complied (within packer variations) with the *Meat Buyer's Guide* (NAMP, 1997). Cutting styles were developed with input from the selected foodservice processors and advisors. Where possible, NAMP (1997) terminology was applied to subprimals and their ready-to-cook products generated as a result of the cutting tests. A number of ready-to-cook cuts and resulting by-products were not identified by NAMP (1997), and common terminology was used. Because the U.S. foodservice industry markets ready-to-cook products on a per-ounce basis, we have included those measures along with comparable gram equivalents.

Data Collection

Bone-in and boneless subprimals were fabricated into ready-to-cook foodservice cuts and component parts by professional foodservice meat cutters to mimic industry practices. Cutting tests performed by the experienced meat cutters were monitored by trained technicians, who recorded the time to complete each phase of the activity to the nearest 0.01 s using hand-held stopwatches.

Meat cutting activities were divided into five major phases of the fabrication/portioning process: opening (simulated or actual retrieval of subprimal from vacuum-packaged bag), cutting (producing ready-to-cook foodservice portion cuts), boning (removal of lean trimmings from bones or large fat depots), trimming (trimming of external fat before cutting), and traying (placing foodservice cuts on trays) as described in Lorenzen et al. (1997). Other times that were specific to certain subprimals included the following: sawing (cutting bone-in product with a bandsaw), skinning (removing heavy epimysium with a skinning machine), and blade tenderizing (blade tenderization of product). Recording times for each phase of the cutting operation allowed the calculation of either total time required to complete the cutting test, or to examine each phase individually. In addition, the technician ensured that each test was thoroughly completed and all components accounted for before proceeding to the next cutting test. All subprimals were weighed before fabrication to ensure that component weights, when summed together, resulted in an aggregated total weight equal to 99% of the initial subprimal weight.

After each cutting test, weights of foodservice cuts, lean trim, fat trim, and bone were recorded by a trained technician.

Fabricated Styles

Beef Rib, Roast-Ready (n = 3), similar to NAMP #109 (NAMP, 1997), yielded USDA Choice French-style ribeye steaks, 10-oz (284-g) boneless ribeye steaks (NAMP #1112A), lean trimmings, fat trimmings, and bone.

Beef Rib, Ribeye Roll, Lip-On, Bone-In (n = 3), similar to NAMP #109E, yielded USDA Choice French-style ribeye steaks, 10-oz (284-g) boneless ribeye steaks (NAMP #1112A), lean trimmings, fat trimmings, and bone.

Beef Brisket, Deckle-Off, Boneless (n = 7), similar to NAMP #120, yielded USDA Choice boneless brisket, flat cut (NAMP #120A), lean trimmings, and fat trimmings.

Beef Round, Top (Inside), Untrimmed (n = 6), similar to NAMP #168, yielded USDA Choice boneless inside round, cap off (NAMP #169A), stew meat (NAMP #135A), cubed material, lean trimmings, and fat trimmings.

Beef Loin, Bottom Sirloin Butt, Flap, Boneless (n = 5), similar to NAMP #185A, yielded USDA Choice boneless defatted flap and lean trimmings.

Beef Rib, Ribeye Roll (n = 12), similar to NAMP #112A, were processed into two different cutting styles. Style #1 (USDA Prime) yielded 16-oz (454-g) and 12-oz (341-g) boneless ribeye steaks (NAMP #1112A), end steaks, and lean trimmings. Style #2 (USDA Prime) yielded 16-oz (454-g) boneless ribeye steaks (NAMP #1112A), end steaks, lean trimmings, and fat trimmings.

Beef Loin, Top Sirloin, Cap (n = 9), similar to NAMP #184D, were processed into two different cutting styles. Style #1 yielded USDA Choice 4-oz (114-g) boneless top sirloin cap steaks (NAMP #1184D), stew meat (NAMP #135A), and lean trimmings. Style #2 yielded USDA Choice 12-oz (341-g) and 4.5-oz (128-g) boneless top sirloin cap steaks (NAMP #1184D), kabob meat (NAMP #135B), and lean trimmings.

Beef Loin, Tenderloin, Butt, Defatted (n = 24), similar to NAMP #191A, were processed into two different cutting styles. Both Style #1 and Style #2 yielded USDA Select 12-oz (341-g), 11-oz (312-g), 10-oz (284-g), 9-oz (255-g), 8-oz (227-g), 7-oz (199-g), and 6-oz (170-g) tenderloin steaks (NAMP #1189A), stew meat (NAMP #135A), tenderloin strips, skin, and lean trimmings.

Beef Rib, Ribeye Roll, Lip-On (n = 24), similar to NAMP #112A, were processed into four different cutting styles. Style #1 (USDA Choice) yielded 14-oz (397-g), 12-oz (341-g) and 8-oz (227-g) boneless ribeye steaks (NAMP #1112A), end steaks, lean trimmings, and fat trimmings. Style #2 (USDA Choice) yielded 14-oz (397-g) and 12.5-oz (355-g) boneless ribeye steaks

Table 1. Mean weights (kg), foodservice yields (%), processing times (s), and SE for NAMP #109 beef rib, roast ready (n = 3)

NAMP# ^a and foodservice cut	Mean	SE
Net weight, kg	13.3	0.3
Foodservice yield	%	
1112A French-style ribeye steaks	30.7	0.5
10-oz. ribeye steaks, bnls. ^b	15.6	1.1
Lean trimmings	11.8	1.2
Bone	13.6	1.4
Fat trimmings	27.7	3.3
Purge	0.0	0.0
Cutting loss	0.6	0.0
Total foodservice yield	58.1	1.9
Processing time, per piece	s	
Opening	23.5	2.8
Boning	55.4	12.5
Trimming	128.9	15.0
Cutting	317.0	36.8
Total time	524.8	39.9

^aNAMP (1997).^bbnls. = boneless.

(NAMP #1112A), end steaks, lean trimmings, and fat trimmings. Style #3 (USDA Choice) yielded 10-oz (284-g) boneless ribeye steaks (NAMP #1112A), end steaks, lean trimmings, and fat trimmings. Style #4 (USDA Prime) yielded 14-oz (397-g) and 10-oz (284-g) boneless ribeye steaks (NAMP #1112A), end steaks, lean trimmings, and fat trimmings.

Beef Loin, Short Loin, short-cut (n = 27), similar to NAMP #174, were processed into five different cutting styles. Style #1 (USDA Choice), yielded 20-oz (568-g), 18-oz (511-g), and 14-oz (397-g) Porterhouse steaks (NAMP #1173), bone, lean trimmings, and fat trimmings. Style #2 (USDA Prime) yielded 24-oz (681-g)

Table 2. Mean weights (kg), foodservice yields (%), processing times (s), and SE for NAMP #109E beef rib, ribeye rolls, lip-on, bone in (export style) (n = 3)

NAMP# ^a and foodservice cut	Mean	SE
Net weight, kg	9.0	0.2
Foodservice yield	%	
1112A French-style ribeye steaks	44.5	0.2
10-oz. ribeye steaks, bnls. ^b	21.3	1.3
Lean trimmings	17.9	0.5
Bone	5.9	0.5
Fat trimmings	9.9	0.7
Purge	0.1	0.1
Cutting loss	0.4	0.1
Total foodservice yield	83.7	1.0
Processing time, per piece	s	
Opening	18.3	1.5
Trimming	133.9	16.2
Cutting	269.6	17.0
Total time	421.8	30.6

^aNAMP (1997).^bbnls. = boneless.**Table 3.** Mean weights (kg), foodservice yields (%), processing times (s), and SE for NAMP #120 beef brisket, deckle-off, boneless (n = 7)

NAMP# ^a and foodservice cut	Mean	SE
Net weight, kg	5.2	0.2
Foodservice yield	%	
120A Brisket, flat cut, bnls. ^b	44.8	1.7
Lean trimmings	40.5	1.9
Fat trimmings	14.1	1.8
Purge	0.3	0.1
Cutting loss	0.3	0.1
Total foodservice yield	85.3	1.9
Processing time, per piece	s	
Opening	6.7	1.8
Cutting	44.2	2.4
Total time	50.9	3.0

^aNAMP (1997).^bbnls. = boneless.

Porterhouse steaks (NAMP #1173), 20-oz (568-g) and 10-oz (284-g) boneless strip steaks (NAMP #1180), end steaks, medallions, tips, bone, lean trimmings, and fat trimmings. Style #3 (USDA Choice) yielded 24-oz (681-g) Porterhouse steaks (NAMP #1173), 20-oz (568-g) and 10-oz (284-g) boneless strip steaks (NAMP #1180), end steaks, medallions, tips, bone, lean trimmings, and fat trimmings. Style #4 (USDA Choice) yielded 20-oz (568-g) and 18-oz (511-g) Porterhouse steaks (NAMP #1173), 14-oz (397-g), 12-oz (341-g), 10-oz (284-g), and 6-oz (170-g) boneless strip steaks (NAMP #1180), stew meat (NAMP #135A), 50% lean trimmings, bone, lean trimmings, and fat trimmings. Style #5 (USDA Choice) 0 (0 cm) × 1 (2.5 cm), trimmed to 0.63 cm of external fat, yielded 24-oz (681-g) Porterhouse steaks (NAMP #1173), 20-oz (568-g) T-bone

Table 4. Mean weights (kg), foodservice yields (%), processing times (s), and SE for NAMP #168 beef round, top (inside), untrimmed (n = 6)

NAMP# ^a and foodservice cut	Mean	SE
Net weight, kg	9.2	0.4
Foodservice yield	%	
169A Inside round, cap-off, bnls. ^b	51.7	1.4
135A Stew meat	7.8	0.8
Cubed steak	12.8	1.8
Lean trimmings	16.1	1.6
Fat trimmings	10.2	1.4
Purge	0.9	0.1
Cutting loss	0.5	0.1
Total foodservice yield	88.5	1.3
Processing time, per piece	s	
Opening	7.8	0.7
Trimming	47.0	2.7
Cutting	46.5	6.5
Total time	101.3	5.3

^aNAMP (1997).^bbnls. = boneless.

Table 5. Mean weights (kg), foodservice yields (%), processing times (s), and SE for NAMP #185A beef loin, bottom sirloin butt, flap, boneless (n = 5)

NAMP# ^a and foodservice cut	Mean	SE
Net weight, kg	5.9	0.2
Foodservice yield	%	
Defatted flap, bnls. ^b	67.3	1.1
Lean trimmings	31.8	1.0
Purge	0.8	0.3
Cutting loss	0.1	0.1
Total foodservice yield	99.0	0.4
Processing time, per 4 pieces	s	
Opening	6.6	0.2
Cutting	159.9	10.5
Total time	166.6	10.6

^aNAMP (1997).

^bbnls. = boneless.

steaks (NAMP #1174), 16-oz (454-g) boneless strip loin steaks (NAMP #1180), lean trimmings, fat trimmings, and bone.

Beef Loin, Strip Loin, Boneless (n = 27), similar to NAMP #180, were processed into five different cutting styles. Style #1 (USDA Choice) yielded 14-oz (397-g), 10-oz (284-g) and 8-oz (227-g) boneless strip loin steaks (NAMP# 1180A), 6-oz (170-g) boneless vein steaks (NAMP#1180), stew meat (NAMP #135A), and lean trimmings. Style #2 (USDA Choice) yielded 12-oz (341-g), and 10-oz (284-g) boneless strip steaks (NAMP #1180A), 8-oz (227-g) boneless vein steaks (NAMP #1180), center steaks, center trim, vein end steaks, vein trim, vein fat, and strip fat. Style #3 (USDA Prime) yielded 12-oz (341-g), and 10-oz (284-

g) boneless strip steaks (NAMP #1180A), 8-oz (227-g) boneless vein steaks (NAMP #1180), center end steaks, center trim, vein trim, vein fat, and strip fat. Style #4 (USDA Choice) yielded 12-oz (341-g) and 10-oz (284-g) boneless strip steaks (NAMP #1180A), 8-oz (227-g) boneless vein steaks (NAMP #1180), center trim, center fat, vein trim, and vein fat. Style #5 (USDA Choice) 0 (0 cm) × 1 (2.5 cm) yielded 12-oz (341-g), 10-oz (284-g), 9-oz (255-g), and 8-oz (227-g) boneless strip steaks (NAMP #1180A), 10-oz (284-g) boneless vein steaks (NAMP #1180), stew meat (NAMP #135A), lean trimmings, and fat trimmings.

Beef Loin, Top Sirloin Butt, Boneless (n = 30), similar to NAMP #184 or #184B, were processed into five different cutting styles. Style #1 (USDA Prime) yielded 10-oz (284-g) and 7-oz (199-g) boneless top sirloin steaks (NAMP #1184B), top sirloin cap (NAMP #184D), stew meat (NAMP #135A), lean trimmings, and fat trimmings. Style #2 (USDA Choice NAMP #184B Center-Cut), yielded 12-oz (341-g) boneless top sirloin steaks (NAMP #1184B), kabob meat (NAMP #135B), and lean trimmings. Style #3 (USDA Prime) yielded 10-oz (284-g) and 8-oz (227-g) boneless top sirloin steaks (NAMP #1184B), top sirloin cap (NAMP #184D), and lean trimmings. Style #4 (USDA Choice) yielded 12-oz (341-g), 10-oz (284-g), 9-oz (255-g), 8-oz (227-g), 7-oz (199-g), and 6-oz (170-g) boneless top sirloin steaks (NAMP #1184B), top sirloin cap (NAMP #184D), stew meat (NAMP #135A), 50% lean trimmings, 90% lean trimmings, and fat trimmings. Style #5 (USDA Choice) yielded 12-oz (341-g), 10-oz (284-g), 9-oz (255-g), 8-oz (227-g), 7-oz (199-g), 6-oz (170-g), and 5-oz (142-g) boneless top sirloin steaks (NAMP #1184B), top sirloin cap (NAMP #184D), stew meat

Table 6. Mean weights (kg), foodservice yields (%), processing times (s), and SE for different styles of NAMP #112A beef rib, ribeyes, lip-on

NAMP# ^a and foodservice cut	Style #1 (n = 6)	Style #2 (n = 6)
Net weight, kg	5.6 ± 0.3 ^b	6.9 ± 0.3 ^a
Foodservice yield	%	
1112 16-oz. ribeye steaks, bnls. ^b	68.7 ± 1.5	69.3 ± 1.5
1112 12-oz. ribeye steaks, bnls.	3.1 ± 1.4	—
Ends	1.1 ± 0.5	1.2 ± 0.5
Lean trimmings	26.4 ± 0.7 ^c	12.8 ± 0.7 ^d
Fat trimmings	—	15.6 ± 1.6
Purge	0.4 ± 0.2 ^d	1.0 ± 0.2 ^c
Cutting loss	0.3 ± 0.1	0.1 ± 0.1
Total foodservice yield	99.1 ± 1.1 ^c	83.3 ± 1.1 ^d
Processing time, per piece	s	
Opening	1.3 ± 2.2 ^d	18.0 ± 2.2 ^c
Trimming	44.0 ± 6.1 ^d	89.9 ± 6.1 ^c
Cutting	45.6 ± 7.5 ^d	89.0 ± 7.5 ^c
Traying	—	16.0 ± 1.5
Total time	90.9 ± 8.8 ^d	212.9 ± 8.8 ^c

^aNAMP (1997).

^bbnls. = boneless.

^{c,d}Means within a row lacking a common superscript differ (*P* < 0.05).

Table 7. Mean weights (kg), foodservice yields (%), processing times (s), and SE for different styles of NAMP #184D beef loin, top sirloin caps

NAMP# ^a and foodservice cut	Style #1 (n = 6)	Style #2 (n = 3)
Net weight, kg	6.6 ± 0.1 ^a	1.7 ± 0.1 ^b
Foodservice yield	%	
1184D 12-oz. cap steaks, bnls. ^b	—	75.6 ± 5.4
1184D 4.5-oz. cap steaks, bnls.	—	5.4 ± 5.4
1184D 4-oz. cap steaks, bnls.	90.8 ± 1.0	—
135A Stew meat	3.2 ± 1.1	—
135B Kabob meat	—	14.3 ± 1.3
Lean trimmings	1.8 ± 1.0	1.4 ± 1.4
Purge	2.4 ± 0.6	2.9 ± 0.8
Cutting loss	1.8 ± 0.5	0.5 ± 0.7
Total foodservice yield	94.0 ± 1.3	96.5 ± 1.8
Processing time, per 2 or 9 pieces	s	
Opening	5.8 ± 0.3	—
Trimming	—	6.6 ± 2.9
Cutting	102.2 ± 4.2 ^c	41.4 ± 5.9 ^d
Traying	—	3.6 ± 1.8
Total time	108.0 ± 3.2 ^c	51.6 ± 4.5 ^d

^aNAMP (1997).^bbnls. = boneless.^{c,d}Means within a row lacking a common superscript differ ($P < 0.05$).**Table 8.** Mean foodservice yields (%), processing times (s), and SE for different styles of NAMP #191A beef loin, tenderloin butts, defatted

NAMP# ^a and foodservice cut	Style #1 (n = 12)	Style #2 (n = 12)
Net weight, kg	2.3 ± 0.1 ^b	2.6 ± 0.1 ^a
Foodservice yield	%	
1189A 12-oz. tenderloin steaks, bnls. ^b	2.5 ± 1.8	5.4 ± 1.8
1189A 11-oz. tenderloin steaks, bnls.	2.2 ± 1.3	1.0 ± 1.3
1189A 10-oz. tenderloin steaks, bnls.	23.9 ± 6.0	18.0 ± 6.0
1189A 9-oz. tenderloin steaks, bnls.	23.9 ± 3.9 ^c	5.6 ± 3.9 ^d
1189A 8-oz. tenderloin steaks, bnls.	3.5 ± 1.8	7.6 ± 1.8
1189A 7-oz. tenderloin steaks, bnls.	13.9 ± 5.7	28.0 ± 5.7
1189A 6-oz. tenderloin steaks, bnls.	0.7 ± 0.9	1.0 ± 0.9
135A Stew meat	4.1 ± 0.3	4.7 ± 0.3
Tenderloin strip	8.8 ± 0.3 ^d	10.5 ± 0.3 ^c
Lean trimmings	11.3 ± 0.5 ^d	13.5 ± 0.5 ^c
Skin	3.2 ± 0.2	3.4 ± 0.2
Purge	0.8 ± 0.2	0.7 ± 0.2
Cutting loss	1.3 ± 0.3	0.7 ± 0.3
Total foodservice yield	94.8 ± 0.3	95.2 ± 0.3
Processing time, per two pieces	s	
Opening	8.7 ± 0.6 ^c	4.5 ± 0.6 ^d
Trimming	68.9 ± 1.7	65.3 ± 1.7
Cutting	39.3 ± 1.4	39.5 ± 1.4
Skinning	12.0 ± 0.0	12.0 ± 0.0
Total time	128.8 ± 2.5 ^c	121.2 ± 2.5 ^d

^aNAMP (1997).^bbnls. = boneless.^{c,d}Means within a row lacking a common superscript differ ($P < 0.05$).

Table 9. Mean weights (kg), foodservice yields (%), processing times (s), and SE for different styles of NAMP #112A beef rib, ribeyes, lip-on

NAMP# ^a and foodservice cut	Style #1 (n = 6)	Style #2 (n = 6)	Style #3 (n = 6)	Style #4 (n = 6)
Net weight, kg	5.5 ± 0.2 ^b	6.8 ± 0.2 ^a	6.5 ± 0.2 ^a	6.6 ± 0.1 ^a
Foodservice yield	%			
1112A 14-oz. ribeye steaks, bnls. ^b	72.2 ± 1.1 ^e	77.1 ± 1.1 ^d	—	80.9 ± 1.1 ^c
1112A 13-oz. ribeye steaks, bnls.	—	1.7 ± 1.7	—	—
1112A 12-oz. ribeye steaks, bnls.	2.1 ± 1.3	—	—	—
1112A 10-oz. ribeye steaks, bnls.	—	—	67.6 ± 1.1 ^c	1.5 ± 1.1 ^d
1112A 8-oz. ribeye steaks, bnls.	0.7 ± 0.7	—	—	—
Ends	—	2.4 ± 0.4	1.3 ± 0.4	1.2 ± 0.4
Lean trimmings	24.3 ± 1.0 ^c	8.1 ± 1.0 ^e	14.3 ± 1.0 ^d	7.8 ± 1.0 ^e
Fat trimmings	—	9.3 ± 1.0 ^d	16.0 ± 1.0 ^c	8.1 ± 1.0 ^d
Purge	0.5 ± 0.2	0.4 ± 0.2	0.5 ± 0.2	0.5 ± 0.2
Cutting loss	0.2 ± 0.8	1.0 ± 0.8	0.2 ± 0.8	0.0 ± 0.8
Total foodservice yield	99.0 ± 1.6 ^c	88.4 ± 1.6 ^d	83.0 ± 1.6 ^e	91.4 ± 1.6 ^d
Processing time, per piece	s			
Opening	—	15.5 ± 2.4	18.6 ± 2.4	15.5 ± 2.4
Trimming (1)	44.3 ± 10.8 ^e	77.3 ± 10.8 ^{cd}	83.1 ± 10.8 ^c	59.8 ± 10.8 ^{cde}
Trimming (2)	—	28.0 ± 5.8	—	—
Cutting	74.6 ± 17.2 ^e	187.5 ± 17.2 ^c	157.0 ± 17.2 ^{cd}	160.3 ± 17.2 ^{cd}
Traying	—	—	18.5 ± 3.1	16.2 ± 3.1
Total time	118.9 ± 12.0 ^e	308.3 ± 12.0 ^c	277.2 ± 12.0 ^{cd}	251.7 ± 12.0 ^d

^aNAMP (1997).^bbnls. = boneless.^{c,d,e}Means within a row lacking a common superscript differ ($P < 0.05$).

(NAMP #135A), 50% lean trimmings, 90% lean trimmings, and fat trimmings.

Beef Loin, Tenderloin, Full, Side Muscle On, Defatted (n = 48), similar to NAMP #189A, were processed into six different cutting styles. Style #1 (USDA Choice) yielded 8-oz (227-g) and 4-oz (114-g) boneless tenderloin steaks (NAMP #1189A), 2-oz (57-g) tenderloin pieces, tenderloin tips (NAMP #1190C), lean trimmings, and skin. Style #2 (USDA Choice) yielded 8-oz (227-g), and 4-oz (114-g) boneless tenderloin steaks (NAMP #1189A), 2-oz (57-g) tenderloin pieces, tenderloin tips (NAMP #1190C), lean trimmings, and skin. Style #3 (USDA Choice) yielded 12.5-oz (355-g) and 4-oz (114-g) boneless tenderloin steaks (NAMP #1189A), 2-oz (57-g) tenderloin pieces, tenderloin tips (NAMP #1190C), lean trimmings, and skin. Style #4 (USDA Choice) yielded 14-oz (397-g) and 4-oz (114-g) boneless tenderloin steaks (NAMP #1189A), tenderloin medallions, tenderloin tips (NAMP #1190C), lean trimmings and skin. Style #5 (USDA Choice) yielded 8-oz (227-g), 7-oz (199-g), and 4-oz (114-g) boneless tenderloin steaks (NAMP #1189A), lean trimmings, tenderloin strip, tenderloin tail, and stew meat (NAMP #135A). Style #6 (USDA Choice) yielded 9-oz (255-g) boneless tenderloin steaks (NAMP #1189A), 1-oz (28-g) tenderloin pieces, tenderloin tail, lean trimmings, and skin.

Data Analysis

Once fabrication was completed, data were analyzed (SAS, Inst. Inc., Cary, NC) to determine means and standard errors on percentage yields and labor times for each subprimal. For comparison of labor and cutting time for cutting styles within a given subprimal, analysis of variance was performed using the general linear models. When analysis of variance indicated significance ($P < 0.05$), style least squares means were further separated using pairwise t-tests.

Results and Discussion

Foodservice cuts and associated components from various stand-alone cutting tests including rib-roast ready; ribeye roll, lip-on, bone-in; boneless brisket, deckle-off; inside round; and bottom sirloin flap were evaluated for mean foodservice yields and processing times and are displayed in Tables 1 through 5. These subprimals contained one cutting style and no comparisons within cuts were made.

Means and standard errors for different fabrication styles for NAMP #112A beef rib, ribeyes, lip-on and for percentage of foodservice yields and processing times are reported in Table 6. Differences ($P < 0.05$) in foodservice yield were found between Style #1 and Style #2, with Style #1 having a higher yield than

Table 10. Mean weights (kg), foodservice yields (%), processing times (s), and SE for different styles of NAMP #174 beef loin, short loins, short-cut

NAMP# ^a and foodservice cut	Style #1 (n = 6)	Style #2 (n = 6)	Style #3 (n = 6)	Style #4 (n = 6)	Style #5 (n = 6)
Net weight, kg	9.8 ± 0.2 ^c	9.9 ± 0.2 ^c	11.7 ± 0.2 ^a	10.6 ± 0.2 ^b	10.5 ± 0.3 ^{bc}
Foodservice yield	%				
1173 24-oz. Porterhouse steaks	—	32.7 ± 1.8 ^d	30.7 ± 1.8 ^d	—	43.3 ± 2.5 ^c
1173 20-oz. Porterhouse steaks	22.5 ± 7.2	—	—	37.4 ± 7.2	—
1174 20-oz. T-bone steaks	—	—	—	—	16.5 ± 3.3
1180 20-oz. strip steaks, bnls. ^b	—	14.8 ± 1.1	15.8 ± 1.1	—	—
1173 18-oz. Porterhouse steaks	0.9 ± 0.9	—	—	0.8 ± 0.9	—
1180 16-oz. strip steaks, bnls.	—	—	—	—	22.1 ± 1.4
1173 14-oz. Porterhouse steaks	24.6 ± 11.0	—	—	—	—
1180 14-oz. strip steaks, bnls.	—	—	—	11.4 ± 0.8	—
1180 12-oz. strip steaks, bnls.	—	—	—	1.1 ± 0.7	—
1180 10-oz. strip steaks, bnls.	—	2.3 ± 0.5 ^c	0.8 ± 0.5 ^{cd}	0.5 ± 0.5 ^d	—
1180 6-oz. strip steaks, bnls.	—	—	—	0.5 ± 0.3	—
135A Stew meat (1)	—	—	—	2.2 ± 0.2	—
135A Stew meat (2)	—	—	—	0.1 ± 0.1	—
End steaks	—	1.1 ± 0.2	1.2 ± 0.2	—	—
Medallions	—	1.1 ± 0.1	1.2 ± 0.1	—	—
Tips	—	0.4 ± 0.1	0.2 ± 0.1	—	—
Center	13.7 ± 1.3	—	—	—	—
50% lean trimmings (1)	—	—	—	20.1 ± 1.2	—
50% lean trimmings (2)	—	—	—	9.1 ± 0.8	—
Lean trimmings	14.9 ± 0.9 ^c	8.8 ± 0.9 ^d	8.8 ± 0.9 ^{de}	—	5.8 ± 1.3 ^{de}
Bone	6.4 ± 1.1 ^e	14.9 ± 1.1 ^c	13.7 ± 1.1 ^{cd}	14.5 ± 1.1 ^{cd}	5.4 ± 1.5 ^e
Fat trimmings	15.3 ± 1.6 ^d	23.1 ± 1.6 ^c	26.3 ± 1.6 ^c	—	4.4 ± 2.2 ^e
Purge	-0.1 ± 0.2	0.5 ± 0.2	0.4 ± 0.2	0.3 ± 0.2	0.3 ± 0.3
Foodservice yield	%				
Cutting loss	1.8 ± 0.3 ^{cd}	0.4 ± 0.3 ^e	0.8 ± 0.3 ^e	2.0 ± 0.3 ^{cd}	2.1 ± 0.5 ^c
Total foodservice yield	76.5 ± 1.6 ^d	61.1 ± 1.6 ^e	58.7 ± 1.6 ^e	83.2 ± 1.6 ^e	87.8 ± 2.2 ^c
Processing time, per piece	s				
Opening	9.0 ± 1.0 ^{de}	11.5 ± 1.0 ^d	11.0 ± 1.0 ^{de}	—	19.5 ± 1.3 ^c
Trimming (1)	54.7 ± 8.7 ^d	137.3 ± 8.7 ^c	137.4 ± 8.7 ^c	39.0 ± 8.7 ^{de}	16.0 ± 12.4 ^e
Trimming (2)	21.2 ± 4.6 ^e	48.8 ± 4.6 ^d	63.0 ± 4.6 ^c	38.7 ± 4.6 ^d	—
Trimming (3)	—	39.8 ± 2.1 ^c	35.3 ± 2.1 ^c	15.8 ± 2.1 ^d	—
Sawing	—	44.9 ± 6.4	44.6 ± 6.4	—	—
Boning	—	32.4 ± 2.6	25.1 ± 2.6	—	—
Cutting (1)	80.7 ± 7.0 ^e	55.6 ± 7.0 ^f	61.2 ± 7.0 ^{ef}	108.1 ± 7.0 ^d	162.7 ± 9.9 ^c
Cutting (2)	—	—	—	77.5 ± 6.3	—
Total time	165.5 ± 12.4 ^e	370.3 ± 12.4 ^c	377.6 ± 12.4 ^c	279.0 ± 12.4 ^d	198.0 ± 17.5 ^e

^aNAMP (1997).^bbnls. = boneless.^{c,d,e,f}Means within a row lacking a common superscript differ ($P < 0.05$).

Style #2. Style #2 also required the most total processing time ($P < 0.05$), possibly due to the separation of fat and lean trimmings, which was not performed in Style #1.

Data relating to foodservice yields and processing times for NAMP #184D, beef loin, top sirloin, caps are presented in Table 7. No differences ($P > 0.05$) in foodservice yield were found between Style #1 and Style #2, although Style #1 had a greater ($P < 0.05$) amount of purge. However, Style #1 required the most ($P < 0.05$) total processing time, possibly due to the smaller portion-sized steaks, resulting in more total steaks and thus more cutting time required. McNeill et al. (1998) found similar results, observing total pro-

cessing time increasing as the number of retail cuts from subprimals increased.

Table 8 shows mean foodservice yields, processing times, and SE for different fabrication styles of NAMP #191A beef loin, tenderloin butts, defatted. No differences ($P > 0.05$) in foodservice yield were found between Style #1 and Style #2. However, total processing time between Style #1 and Style #2 were different ($P < 0.05$), due to a greater opening time ($P < 0.05$) for Style #1.

Mean foodservice yields, processing times, and SE for different fabrication styles of NAMP #112A beef rib, ribeyes, lip-on are displayed in Table 9. Style #1 had the greatest total foodservice yield ($P < 0.05$). This

Table 11. Mean weights (kg), foodservice yields (%), processing times (s), and SE for different styles of NAMP 180 beef loin, strip loins, boneless

NAMP# ^a and foodservice cut	Style #1 (n = 6)	Style #2 (n = 5)	Style #3 (n = 5)	Style #4 (n = 5)	Style #5 (n = 6)
Net weight, kg	5.4 ± 0.2 ^c	6.2 ± 0.3 ^b	7.1 ± 0.3 ^a	4.6 ± 0.3 ^d	5.5 ± 0.2 ^c
Foodservice yield	%				
1180A 14-oz. strip loin steaks, bnls. ^b	46.5 ± 2.5	—	—	—	—
1180A 12-oz. strip loin steaks, bnls.	—	41.3 ± 2.0	40.4 ± 2.0	54.7 ± 2.0	46.4 ± 2.0
1180A 10-oz. strip loin steaks, bnls.	5.5 ± 4.1	11.6 ± 4.5	13.3 ± 4.5	1.7 ± 4.5	9.0 ± 4.1
1180A 9-oz. strip loin steaks, bnls.	—	—	—	—	0.8 ± 0.8
1180A 8-oz. strip loin steaks, bnls.	3.9 ± 1.2	—	—	—	0.7 ± 1.2
1180 6-oz. vein steaks, bnls.	1.0 ± 0.7	—	—	—	—
1180 10-oz. vein steaks, bnls.	—	—	—	—	16.3 ± 1.6
1180 8-oz. vein steaks, bnls.	—	15.3 ± 1.1 ^d	14.3 ± 1.1 ^c	22.0 ± 1.1 ^c	—
135A Stew meat	1.9 ± 0.3 ^c	—	—	—	0.3 ± 0.3 ^d
Center end steak	—	1.1 ± 0.1	1.0 ± 0.1	—	—
Center trim	—	—	—	5.1 ± 1.3	—
Center fat	—	—	—	7.3 ± 2.1	—
Vein end steak	—	0.8 ± 0.3	—	—	—
Vein trim	—	1.8 ± 0.4	1.7 ± 0.4	2.4 ± 0.4	—
Vein fat	—	1.7 ± 0.4 ^{cd}	0.7 ± 0.4 ^d	2.5 ± 0.4 ^c	—
Strip fat	—	25.3 ± 2.5	26.6 ± 2.5	—	—
Lean trimmings	40.2 ± 2.0 ^c	—	—	—	17.9 ± 2.0 ^d
Fat trimmings	—	—	—	—	6.5 ± 0.6
Purge	0.7 ± 0.4 ^{ddef}	0.9 ± 0.4 ^{def}	1.4 ± 0.4 ^d	4.0 ± 0.4 ^c	1.2 ± 0.4 ^{de}
Cutting loss	0.3 ± 0.2	0.2 ± 0.3	0.6 ± 0.3	0.4 ± 0.3	0.8 ± 0.2
Total foodservice yield	99.1 ± 1.5 ^c	73.6 ± 1.6 ^e	71.4 ± 1.6 ^e	95.7 ± 1.6 ^{cd}	91.5 ± 1.5 ^d
Processing time, per piece	s				
Opening	—	8.9 ± 1.4 ^{cd}	13.0 ± 1.4 ^c	10.6 ± 1.4 ^{cd}	8.0 ± 1.3 ^d
Trimming	54.2 ± 4.5 ^e	83.8 ± 4.9 ^{cd}	83.8 ± 4.9 ^{cd}	48.2 ± 4.9 ^e	86.0 ± 4.5 ^c
Cutting (1)	—	90.8 ± 8.4	82.9 ± 8.4	85.4 ± 8.4	—
Cutting (2)	—	37.7 ± 6.0 ^d	31.6 ± 6.0 ^d	61.0 ± 6.0 ^c	—
Cutting (3)	107.0 ± 16.0 ^c	—	—	—	38.2 ± 16.0 ^d
Traying	—	1.7 ± 1.7	—	—	—
Total time	161.2 ± 15.2 ^{ef}	222.9 ± 16.7 ^c	211.3 ± 16.7 ^{cd}	205.2 ± 16.7 ^{cd}	132.2 ± 15.2 ^f

^aNAMP (1997).

^bbnls. = boneless.

^{c,d,e,f}Means within a row lacking a common superscript differ ($P < 0.05$).

was possibly because this fabrication style did not separate lean and fat trimmings, whereas styles #2, #3, and #4 did. Style #2 required the greatest ($P < 0.05$) total processing time, whereas Style #1 ($P < 0.05$) required the least. These differences were similar to the findings of McNeill et al. (1998), who found an inverse relationship between processing time and retail yields.

Results of cutting tests on beef loin, short loins, short-cut (NAMP #174) are presented in Table 10 by mean foodservice yields, processing times, and SE for five different fabrication styles. Styles #4 and #5 were similar ($P > 0.05$) and had the greatest total foodservice yields. This was possibly due to the fact that these styles had considerably less ($P < 0.05$) fat trimmings when compared with Styles #1, #2 and #3. Styles #2 and #3 were similar ($P > 0.05$) with the lowest total foodservice yields and required the greatest total processing time. Furthermore, Style #4 required an intermediate ($P < 0.05$) amount of processing time and

Styles #1 and #5 required the least ($P < 0.05$) total processing time.

Means and standard errors of different fabrication styles of beef loin, strip loins, boneless (NAMP #180), and for percentage foodservice yields and processing times are reported in Table 11. Styles #2 and #3 were similar ($P > 0.05$) with the lowest total foodservice yield ($P < 0.05$), whereas Style #1 had the greatest ($P < 0.05$). No differences ($P > 0.05$) were observed for total processing time among Styles #2, #3, and #4, whereas Style #5 required the least ($P < 0.05$). These results are also similar to the findings of Lorenzen et al. (1996a), in which significant variations in yields and times within cutting styles of pork were found.

Data relating to foodservice yields and processing times for beef loin, top sirloin butts, boneless (NAMP #184) are presented in Table 12. Styles #2 and #3 were similar ($P > 0.05$) with the highest percentage of total foodservice yield, whereas Styles #1, #4, and #5 were similar ($P > 0.05$) with the lowest percentage of total

Table 12. Mean weights (kg), foodservice yields (%), processing times (s), and SE for different styles of NAMP #184 and #184B beef loin, top sirloin butt, boneless

NAMP# ^a and foodservice cut	Style #1 (n = 6)	Style #2 (n = 6)	Style #3 (n = 6)	Style #4 (n = 6)	Style #5 (n = 6)
Net weight, kg	6.0 ± 0.2 ^a	2.9 ± 0.2 ^b	6.0 ± 0.2 ^a	6.5 ± 0.2 ^a	6.4 ± 0.2 ^a
Foodservice yield	%				
1184B 12-oz. Top sirloin steaks, bnls. ^b	—	82.8 ± 1.4 ^c	—	1.5 ± 1.4 ^d	1.8 ± 1.4 ^d
1184B 10-oz. Top sirloin steaks, bnls.	34.1 ± 3.0 ^d	—	43.4 ± 3.0 ^c	1.3 ± 3.0 ^f	11.1 ± 3.0 ^e
1184B 9-oz. Top sirloin steaks, bnls.	—	—	—	0.7 ± 0.7	0.7 ± 0.7
1184B 8-oz. Top sirloin steaks, bnls.	—	—	4.2 ± 3.2 ^d	21.9 ± 3.2 ^c	16.5 ± 3.2 ^c
1184B 7-oz. Top sirloin steaks, bnls.	1.1 ± 1.2	—	—	3.1 ± 1.2	3.5 ± 1.2
1184B 6-oz. Top sirloin steaks, bnls.	—	—	—	5.2 ± 1.1 ^c	0.4 ± 1.1 ^d
1184B 5-oz. Top sirloin steaks, bnls.	—	—	—	—	0.4 ± 0.4
184D Top sirloin caps	12.3 ± 0.7 ^{de}	—	30.1 ± 0.7 ^c	12.6 ± 0.7 ^d	12.2 ± 0.7 ^e
135A Stew meat	3.2 ± 0.5	—	—	3.3 ± 0.5	2.0 ± 0.5
135B Kabob meat	—	7.1 ± 1.0	—	—	—
50% lean trimmings	—	—	—	22.3 ± 1.6	25.9 ± 1.6
90% lean trimmings	—	—	—	7.4 ± 0.7	6.7 ± 0.7
Lean trimmings	25.6 ± 1.7 ^c	8.4 ± 1.7 ^d	22.0 ± 1.7 ^c	—	—
Fat trimmings	22.8 ± 2.1	—	—	19.1 ± 2.1	17.5 ± 2.1
Purge	0.8 ± 0.2 ^{cd}	0.9 ± 0.2 ^c	0.1 ± 0.2 ^e	0.6 ± 0.2 ^{cde}	0.6 ± 0.2 ^{cde}
Cutting loss	0.0 ± 0.2 ^f	0.9 ± 0.2 ^{cd}	0.3 ± 0.2 ^{def}	0.9 ± 0.2 ^c	0.8 ± 0.2 ^{cde}
Total foodservice yield	73.3 ± 1.9 ^{de}	98.3 ± 1.9 ^c	99.7 ± 1.9 ^c	76.6 ± 1.9 ^{de}	78.6 ± 1.9 ^d
Processing time	s				
Opening	11.2 ± 1.3 ^c	—	2.7 ± 1.3 ^e	7.3 ± 1.3 ^d	9.8 ± 1.3 ^{cd}
Blade tenderizing	—	—	22.6 ± 10.2	—	—
Trimming (1)	89.9 ± 6.5 ^e	30.0 ± 6.5 ^f	32.6 ± 6.5 ^f	181.0 ± 6.5 ^c	145.9 ± 6.5 ^d
Cutting (1)	110.6 ± 5.4 ^c	24.6 ± 5.4 ^f	77.2 ± 5.4 ^d	70.2 ± 5.4 ^{de}	58.6 ± 5.4 ^e
Processing time, per piece	s				
Cutting (2)	—	24.5 ± 6.6	—	—	—
Trimming (2)	59.9 ± 3.8 ^c	20.4 ± 3.8 ^d	—	—	—
Traying	—	16.7 ± 2.4	—	—	—
Total time	271.6 ± 10.5 ^c	116.2 ± 10.5 ^e	135.1 ± 10.5 ^e	258.4 ± 10.5 ^c	214.4 ± 10.5 ^d

^aNAMP (1997).^bbnls. = boneless.^{c,d,e,f}Means within a row lacking a common superscript differ ($P < 0.05$).

foodservice yield. Styles #1 and #4 required the greatest, whereas Styles #2 and #3 required the least total processing time. Furthermore, Style #5 was different ($P < 0.05$) from all other cutting styles for total processing time.

Table 13 shows mean foodservice yields, processing times, and SE for six different fabrication styles of NAMP #189A beef, loin, tenderloins, full, side muscle on, defatted (often referred to in the meat industry as *PSMO tenderloins*). Considerable differences were found between all cutting styles with regards to percentage of total foodservice yield. Styles #1 and #5 were similar ($P > 0.05$) with the greatest total foodservice yield, whereas Style #6 was found to have the lowest ($P < 0.05$) foodservice yield. These differences between all cutting styles could be attributed to the fact that differences were found in lean trimmings, skin, purge and cutting loss, factors all affecting foodservice yield. Style #1 required the greatest ($P < 0.05$) amount of total processing time compared with all other fabrication styles, whereas Style #6 was found to require the least ($P < 0.05$) total processing time.

In conclusion, as the target portion size decreased, the number of steaks increased, causing total foodservice yield to decrease and total processing time to increase. Overall, results from this study were similar to the findings of past research (Lorenzen et al., 1996a; McNeill et al., 1998). Significant variations in yields and times were found within cutting styles as found by Lorenzen et al. (1996a). As the total number of cuts increased, total processing time increased and an inverse relationship between processing times and yields was found, similar to the results of McNeill et al. (1998).

Implications

Standardized and independently collected yield and time information for the conversion of beef subprimals into foodservice ready-to-cook products has not been widely available. These data will serve as benchmarks for foodservice operators and purveyors to use in comparing various purchasing and merchandising options as well as the effects of various labor times and costs

Table 13. Mean weights (kg), foodservice yields (%), processing times (s), and SE for different styles of NAMP #189A beef loin, tenderloins, full, side muscle on, defatted

NAMP# ^a and foodservice cut	Style #1 (n = 6)	Style #2 (n = 6)	Style #3 (n = 6)	Style #4 (n = 6)	Style #5 (n = 12)	Style #6 (n = 12)
Net weight, kg	2.8 ± 0.1 ^b	3.1 ± 0.1 ^a	2.8 ± 0.1 ^b	3.1 ± 0.1 ^a	2.4 ± 0.1 ^c	2.7 ± 0.7 ^b
Foodservice yield	%					
1189A 14-oz. tenderloin steaks	—	—	—	43.0 ± 1.7	—	—
1189A 12.5-oz. tenderloin steaks	—	—	69.2 ± 1.6	—	—	—
1189A 9-oz. tenderloin steaks	—	—	—	—	—	63.1 ± 1.1
1189A 8-oz. tenderloin steaks	55.0 ± 2.2 ^c	54.1 ± 2.2 ^c	—	—	43.7 ± 1.6 ^d	—
1189A 7-oz. tenderloin steaks	—	—	—	—	17.0 ± 0.5	—
1189A 4-oz. tenderloin steaks	3.3 ± 1.2 ^c	5.5 ± 1.2 ^c	2.8 ± 1.2 ^c	3.9 ± 1.2 ^c	1.2 ± 0.9 ^d	—
135A Stew meat	—	—	—	—	2.1 ± 0.1	—
1190C Tenderloin tips	6.2 ± 0.9 ^{cd}	5.5 ± 0.9 ^{cd}	7.4 ± 0.9 ^c	0.9 ± 0.9 ^e	—	—
2-oz. tenderloin pieces	4.6 ± 0.8	4.6 ± 0.8	2.1 ± 0.8	—	—	—
1-oz. tenderloin pieces	—	—	—	—	—	3.6 ± 0.6
Medallions	—	—	—	3.2 ± 0.5	—	—
Lean trimmings	28.7 ± 1.3 ^c	26.6 ± 1.3 ^{cd}	14.9 ± 1.3 ^f	13.0 ± 1.3 ^f	24.0 ± 0.9 ^{de}	23.1 ± 0.9 ^e
Head portion	—	—	—	31.8 ± 1.1	—	—
Strip portion	—	—	—	—	4.8 ± 0.3	—
Tail portion	—	—	—	—	5.9 ± 0.5	4.7 ± 0.5
Skin	1.7 ± 0.3 ^e	2.8 ± 0.3 ^d	2.6 ± 0.3 ^{de}	2.7 ± 0.3 ^{de}	—	4.2 ± 0.2 ^c
Purge	1.1 ± 0.2 ^{cd}	1.2 ± 0.2 ^c	0.6 ± 0.2 ^{cd}	1.2 ± 0.2 ^{cd}	0.4 ± 0.2 ^f	0.5 ± 0.2 ^f
Cutting loss	-0.6 ± 0.3 ^g	-0.2 ± 0.3 ^{efg}	0.3 ± 0.3 ^{cd}	0.4 ± 0.3 ^{de}	0.8 ± 0.2 ^c	0.8 ± 0.2 ^{cd}
Total foodservice yield	97.8 ± 0.5 ^{cd}	96.2 ± 0.5 ^{ef}	96.5 ± 0.5 ^{de}	95.8 ± 0.5 ^{ef}	98.8 ± 0.4 ^c	94.5 ± 0.4 ^g
Processing time, per piece	s					
Cutting (1)	83.1 ± 4.3 ^c	61.6 ± 4.3 ^{de}	68.9 ± 4.3 ^d	55.3 ± 4.3 ^e	39.9 ± 3.0 ^f	36.6 ± 3.0 ^f
Trimming	62.0 ± 4.0 ^d	61.2 ± 4.0 ^d	25.5 ± 4.0 ^f	4.7 ± 4.0 ^g	77.3 ± 2.9 ^c	36.6 ± 2.9 ^e
Opening	10.23 ± 1.2 ^c	7.3 ± 1.2 ^{cd}	6.8 ± 1.2 ^{de}	6.5 ± 1.2 ^{def}	5.5 ± 0.8 ^{defg}	3.3 ± 0.8 ^g
Cutting (2)	—	—	—	42.7 ± 6.3	—	—
Traying	11.1 ± 2.8 ^c	2.0 ± 2.8 ^d	0.6 ± 2.8 ^d	—	—	13.1 ± 2.0 ^c
Total time	166.4 ± 7.0 ^c	132.2 ± 7.0 ^d	101.8 ± 7.0 ^{fg}	109.2 ± 7.0 ^{ef}	122.6 ± 5.0 ^{de}	89.7 ± 5.0 ^g

^aNAMP (1997).

^bbnls. = boneless.

^{c,d,e,f,g}Means within a row lacking a common superscript differ (*P* < 0.05).

in preparing beef items for the hotel, restaurant, and institutional markets.

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