THE EFFECT OF SPRAY CHILLING ON BEEF CARCASS COOLER SHRINK, BEEF WHOLESALE CUT PURGE, AND BEEF RETAIL CUT COOKING LOSSES

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Background

Spray chilling beef carcasses immediately following harvest has been widely accepted among beef packers in North America; however, this practice is not as widely accepted in other major beef packing areas of the world. A major concern of spray chilling is the shrink that might be encountered by the consumer from spray-chilled beef, both in terms of the drip loss or purge and cooking losses. This study was conducted to evaluate the effect of chilling method upon carcass shrink, wholesale cut purge, and cooking losses.

Objective

There are many factors that influence normal fluid loss during the chilling of beef carcasses (Lawrie, 1991). Spray chilling involves the spraying of water onto carcasses during chilling to counter the effects of evaporative weight loss during the first 24 h postmortem. These systems have been shown to reduce carcass shrink from 0.5 to 1.5% (Kastner, 1981). This study investigates the effects of chilling method on carcass shrink, vacuum-packaged wholesale cut purge, and cooking loss in thawed beefsteaks.

Methods

Sixteen crossbred beef heifers were harvested in four groups. At harvest, each side of the carcass was weighed prior to placement in a cooler. The right side of each carcass was spray chilled in a cooler at 3-5C. The left side of each carcass was placed in a cooler without spray chill at 3-5C. The spray system was activated immediately after placement in the cooler, and sides were sprayed for three minutes. The system was then off for 27 minutes. This cycle was repeated for 12 h (12 h spray chilled and dry chilled 36 h). After this 48-h chilling period, carcass sides were weighed. Carcasses were then evaluated for yield and quality grades according to USDA (1976) standards.

Seven days following harvest, each side was quartered and weighed. The forequarter was then fabricated into wholesale cuts; cuts were weighed and vacuum packaged. After an additional 24 h, hindquarters were fabricated into wholesale cuts, cuts were weighed and then vacuum packaged. Each wholesale cut was then placed into a cooler at 3-5 C. After a 3-4 d storage period, the wholesale cuts of the rib (IMPS107) and top round (IMPS 168) were removed from the vacuum package and weighed. The longissimus dorsi and the semi-membranosus were removed from the rib and top round, respectively, and three steak samples were cut from each muscle. The first steak was used for water holding capacity testing described by Wierbicki (1958) and non-cooked drip testing using the AMSA guidelines (2000); the second and third steak samples were placed into a -30 C freezer for later evaluation. The steak samples were then cooked according to the AMSA (1995) cookery guidelines. Six cores samples (1.27 cm o.d.) were then subjected to Warner-Bratzler shear to determine instrumental tenderness.

Data were subjected to analysis of variance for a completely randomized design (SAS Inst., Cary, NC). In order to evaluate the change in carcass side weight, wholesale cut weight and cooked steak weight final weight was evaluated using initial weight as a covariate.

Results and Discussion

Within the first 48 h postmortem, spray chilling reduced shrink when hot carcass weight was used as covariate ($P<0.001$; Table 1). This is in agreement with other spray-chill tests (Johnson, 1988; Hippe, 1990). Although the difference between the two chilling methods seemed to visually narrow at 168 h (Figure 1), chilling method did not influence carcass side weights at 168 h after harvest when either 48-h side weight was used as a covariate ($P=0.16$) or when a covariate was not used ($P=0.75$). Purge loss in vacuum packaging did not differ for wholesale cuts tested when either weight before packaging was used as a covariate ($P=0.73$) or when a covariate was not used ($P=0.51$; Table 2). This agrees with the work done by Jones and Robertson (1988) and Hippe et al. (1990). Evaporation, drip, and total cooking losses did not differ ($P>0.42$) between treatments (Table 3). Shear force values did not differ between treatments ($P=0.38$) with spray-chilled steaks having a mean Warner-Bratzler Shear force of 3.78 kg and conventionally-chilled steaks having a mean shear force of 3.56 kg. Drip loss from non-cooked meat, (data not shown) did not differ between treatments ($P=0.90$; 0.32 and 0.34 +/- 0.002 for spray- and conventionally-chilled, respectively). Water holding capacity did not differ ($P=0.65$) between steaks from spray-chilled carcasses and steaks from conventionally-chilled carcasses (72.01 and 72.36 +/- 0.55%, respectively). Although bacterial load of spray-chilled carcasses has been cited as a concern (Hippe, 1990), the carcasses in this study were required to meet a zero tolerance for *E.coli* and *Salmonella* as required by USDA. Visual assessment and hot water rinse was used for contaminate control prior to placement in coolers.

Conclusion

Spray chilling decreased carcass shrink losses by 1.31% at 48-h and numerically decreased carcass shrink by 0.52% at 168 h postmortem. Wholesale vacuum packaging and retail cooking losses were not affected by the chill treatments used. *E.coli* and *Salmonella* bacterial load does not seem to be a limitation to spray chilling carcasses.

Pertinent Literature

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Table 1. Effect of chilling method on carcass side weight at 0, 48, and 168 hours after harvest.

Trait	Spray Chilled	Conventionally Chilled	SE[a]
Hot side weight, kg	182.39	182.05	2.97
48-hour chilled side wt, kg	180.80	178.08	2.94
48-hour chilled side wt, kg[b,c]	180.13	178.80	0.17
48-h shrink, %	0.87	2.18	
168-hour chilled side wt, kg	178.56	177.26	2.92
168-hour chilled side wt, kg[d]	177.24	177.62	0.19
168-hour shrink, %	2.11	2.63	

[a]Standard error of the least squares mean, n = 16.
[b]Hot side weight used as a covariate.
[c]Effect of chilling method ($P < 0.001$).
[d]48-h side weight used as a covariate.

Table 2. Effect of chilling method on rib and round wholesale cut purge loss

Trait	Spray Chilled	Conventionally Chilled	SE[a]
Rib prior to packaging, kg	11.82	11.60	0.25
Weight after packaging, kg	11.81	11.57	0.25
Weight after packaging, kg[b]	11.69	11.69	0.01
Purge loss, %	0.08	0.26	
Round prior to packaging, kg	9.08	8.98	0.17
Weight after packaging, kg	8.94	8.84	0.17
Weight after packaging, kg[c]	8.88	8.89	0.03
Purge loss, %	1.54	1.56	

[a]Standard error of the least squares mean, n = 16.
[b]Rib weight prior to packaging used as a covariate.
[c]Round weight prior to packaging used as a covariate.

Table 3. Cooking losses and warner bratzler shear values of longissimus steaks from spray- chilled and conventionally -chilled beef carcasses

Trait	Spray Chilled	Conventionally Chilled	SE[a]
Uncooked steak weight, g	470.25	477.93	12.18
Cooked steak weight, g	401.65	404.00	10.03
Cooked steak weight, g[b]	404.53	401.12	4.23
Drip loss, %	6.11	6.32	0.40
Evaporation loss, %	9.14	8.43	0.61
Total cooking loss, %	15.25	14.76	0.81
Shear values, kg	3.78	3.56	0.17

[a]Standard error of the least squares mean, n = 16.
[b]Uncooked steak weight used as a covariate.

Figure 1