EFFECTS OF SPRAY-CHILLING ON CARCASSES WEIGHT LOSS AND ON PHYSICOCHEMICAL QUALITY ON AGED BEEF CUTS

Cristiano S. Prado[1*], Francine O. S. Duarte[1], Maria Izabel A. Souza[1], Moacir E. Lage[1], Cintia S. Minafra-Rezende[1], Antônio, N. Oliveira[1], Edmar S. Nicolau[1]

[1]Food Research Center, Federal University of Goiás, Campus II, GO 462, P.O. Box 23212, Goiânia, Brazil

*Corresponding author email: pradocs@gmail.com

I. INTRODUCTION

Losing water by drip or exudation can influence the juiciness of cooked meat and also the appearance of vacuum packaged meat cuts at the retailers. Weight loss during a conventional chilling can be caused by exudation and surface evaporation, which may reach almost 2%. In order to avoid weight loss during chilling, a spray system has been used in the USA and Canada since 1987 [1]. It consists of a simple device made of PVC pipes with sprinkler nozzles organized side by side to the rails, inside the cooler. Total time of the program, time of spraying cycles and intervals between cycles can influence weight loss. The efficiency of the spray-chilling system has been studied and, has shown, in general, to be effective in reducing weight loss [1,2]. However, depending on how cycles are programmed, carcasses may gain weight instead of losing. The objective of this study was to evaluate the effects of a spray-chilling system on carcasses weight loss and also on purge and cooking losses, shear force and colour of aged chuck tender beef (IMPS 116B) [3].

II. MATERIALS AND METHODS

Eighteen non-castrated bulls (Nelore cattle), aged 24 months on average, were slaughtered according to the Brazilian Regulation. Carcasses were weighted before chilling (initial weight) and randomly assigned into two chilling treatments (n=9 carcasses for each treatment): conventional air chilling (CC) or spraying-chilling (SC). The total spraying time (water at 4°C) for the SC treatment was 2 h, with the first cycle consisting of 180 s spraying, and the subsequent cycles of 60 s spraying, always with a 540 s interval. The post mortem pH decline was measured using a pH meter HANNA brand, model 225, with probes inserted into the M. *Longissimus dorsi*, between ribs 9 and 10. After 24 h of chilling (2°C), carcasses were weighted again (final weight) and weight loss was calculated by weight difference. After chilling, the *Supraspinatus* muscle, commercially named as “chuck tender” (IMPS 116B) [3] from six carcasses from each treatment was deboned, individually vaccum packed and aged for 60 days at a temperature between 0-2°C (n=6 beef cuts for each treatment). After the aging time, in order to calculate the purge loss, packed samples were initially weighed, opened to remove the exudate, then the meat and the vacuum bag were wiped with paper towel and weighed together. Purge loss was calculated by weight differences. Steaks of 2.5 cm thickness from the chuck tender were evaluated for surface colour, Warner-Bratzler shear force and cooking losses. Instrumental meat colour L* (lightness), a* (redness) and b* (yellowness) (CIE LAB) were analyzed using a Minolta model BC-10. Steaks were rested for 30 minutes under room conditions for surface blooming time before the measurements. Next, steaks were cooked using an electric oven with top and bottom electrical resistances. Temperature was adjusted to 170°C (pre-heated) and the steaks internal temperatures were monitored with individual probes until they reached 71°C. Cooking losses were estimated by weight differences before and after cooking. Grilled steaks were packed into individual plastic bags and chilled at 7°C overnight. Six 1.27 cm cores per steak were taken in order to measure the shear force using the Warner-Bratzler Meat Shear (GR manufacturing Co. Manhattan, model 300). The results were evaluated by *R* Statistical Program and mean values were compared by Tukey’s and Duncan’s tests ($p<0.05$).

III. RESULTS AND DISCUSSION

A significant difference ($p<0.001$) was observed on carcasses weight loss when comparing the chilling treatments (Table 1). Sprayed-chilled carcasses group had mean losses of 1.09% while the conventional-chilled group lost 1.73%. These results are similar to those reported by other authors [2, 4, 5], and must be

considered under an industrial view due to the potential economic impact, when considering the weight loss observed in sprayed carcasses saving almost 2.0 kg per animal.

Table 1. Means ± SEM and coefficient of variation (CV) of initial and final weights, and weight loss (kg and percentage) during carcass chilling (n=9 for each chilling treatment).

Treatment	Initial weight (kg)	Final weight (kg)	Weight loss (kg)	Weight loss (%)
SC	289.04 ± 5.56[a]	285.91 ± 5.58[a]	3.13 ± 0.24[a]	1.09 ± 0.09[a]
CC	295.33 ± 5.56[a]	290.24 ± 5.58[a]	5.09 ± 0.24[b]	1.73 ± 0.09[b]
CV (%)	5.70	5.81	17.38	18.49

SC: spray-chilling; CC: conventional air chilling; SEM: standard error of the mean; CV: coefficient of variation; [a,b] Means in the same column with different letters are significantly different (p<0.001).

No effects of spraying-system treatment were observed (p>0.05) in post mortem pH decline and also in the results for purge loss, cooking loss, WB shear-force and on CIE L*, a* and b* values (Table 2). Greer *et al*. [5], when comparing spray and conventional air chilling, also found no difference on purge loss from tenderloins up to 70 days of vacuum storage. However, the present results for purge loss are not in accordance with those from other authors [1, 2], suggesting that the saved weight can be lost during storage. Lack of difference on purge loss between treatments can be explained by the short time of total spraying, by the location of the *Supraspinatus* muscle, on the forequarter, which is far from the source of water during the spraying process and by the similar pH decline between treatments, which could impact the water holding capacity. Similarly, this may be the reason for the lack of difference between treatments on cooking loss. Results for WB shear force and surface colour in the present experiment are in agreement with others authors [2, 1, 4].

Table 2. Means ± SEM and coefficient of variation (CV) for purge loss, cooking loss, WB shear force and instrumental meat colour (L* a* b*) of aged chuck tender steaks by chilling treatment (n = 6).

	Purge loss (%)	Cooking loss (%)	WB (N)	L*	a*	b*
SC	3.63 ± 0.44	12.57 ± 0.67	30.51 ± 1.16	42.08 ± 0.58	17.85 ± 0.64	8.41 ± 0.41
CC	4.72 ± 0.44	10.71 ± 0.67	33.37 ± 1.16	41.33 ± 0.58	18.73 ± 0.64	8.78 ± 0.41
CV (%)	26.06	14.12	8.86	3.43	8.55	11.58

SC: spray-chilling; CC: conventional air chilling; WB: Warner-Bratzler shear force; SEM: standard error of the mean; CV: coefficient of variation.

IV. CONCLUSION

The spray-chilling system is effective in reducing carcass weight loss, despite the short time of spraying evaluated at this experiment. Therefore, it can be used as a technique in order to decrease the economic losses during chilling. Spray-chilling does not affect meat quality attributes in evaluated conditions.

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