

Reduction of chilling losses in beef carcasses by wrapping with polyethylene stretch film

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ABSTRACT - This study was created with the objective of quantifying the reduction of the weight losses of beef carcasses during chilling with the use of polyethylene stretch film. In total, 80 Nellore carcasses were evaluated (40 steers and 40 males non-castrated) with 271±15 kg of hot carcass weight. Each carcass evaluated had one half-carcass chilled WITHOUT the use of the polyethylene stretch film (control) and the other half-carcass chilled WITH the use of the film (experimental), totaling 80 half-carcasses without the use of the film and 80 half-carcasses WITH the use of the film. In steers, with subcutaneous fat thickness ($P=0.01$) greater than males, 6.62±0.66 and 4.25±0.62 mm, respectively, the use of the polyethylene stretch film was not effective ($P>0.05$) in chilling of steers carcasses, with weight losses of 1.51±0.19 WITHOUT and 1.24±0.2 % WITH polyethylene film. However, the use of the film was effective in reducing the losses in weight in the males carcasses, such that, the weight losses were 1.69±0.17 WITHOUT and 0.70±0.18 % WITH the film, representing a difference of one percentage point.

I. INTRODUCTION

During the beef carcasses standard chilling process, there is naturally a weight loss due to surface exudation and dehydration. These losses may range from 0.75 to more than 2%, as observed by Jones e Robertson (1); Kinsella *et al.* (2); Pacheco *et al.* (3); Sampaio, (4) Therefore, several countries, including the United States and Canada, as well as Brazil have been using the spray chilling system to reduce weight loss during chilling (Prado and Felício, 2010).

Savell *et al.* (6) conducted a widely review of carcass chilling and described that, among industrial techniques used to improve the sensory aspects of meat, several stand out: *post-mortem* electrical stimulation immediately after the outset

of *rigor mortis*, delayed chilling or rapid chilling, which consists of extending or accelerating the reduction in temperature of the carcasses, and the use of water spray chilling. However, they do not mention the technique of carcasses chilling with the use of polyethylene film.

The use of the polyethylene film is a new and little studied technique that consists in wrapping each half-carcass before chilling to reduce loss in weight due to evaporation and dripping water.

Therefore, the objective of this study was to quantify the reduction of the weight losses of beef carcasses during chilling with the use of polyethylene stretch film.

II. MATERIALS AND METHODS

The experiment was conducted in a bovine slaughterhouse, registered with the Federal Inspection Service (SIF/MAPA) with the number 3348, in the city of Sinop, Mato Grosso, Brazil. This study was conducted with an experimental approach with the previous authorization of the Inspection Service for Products Originating from Animals (SIPOA) of the Ministry of Agriculture and Food Supplies (MAPA), under article 054/2013.

For the evaluation of chilling losses, 80 Nellore carcasses with 271.6±15.2 kg of hot carcass weight were used, being 40 steers and 40 males non-castrated. Each carcass evaluated had a half-carcass chilled WITHOUT the use of polyethylene stretch film (control group) and the other half-carcass chilled WITH the use of the film (experimental group), defined previously by random selection, making for a total of 80 half-carcasses without the use of the polyethylene film and 80 half-carcasses with the use of the film.

After slaughter routine procedures and before chilling of the half-carcasses, and based on the previous selection, the

transparent polyethylene film (Bobina Stretch, 500 x 0.25 mm model, Stretch Shrink Film, Ltda, Itaquaquecetuba, São Paulo, Brasil) for use exclusively in food technique was applied in simple lap around the selected half-carcasses. The half-carcasses selected for chilling was wrapped by the research team, taking due precautionary for handling with aid of a sanitized equipment (ladder and gloves). Bone and skeletal tissues from the rear end to the muscles in cervical region were wrapped.

After applying the technique, the half-carcasses without and with the film were compulsorily chilled in the same refrigeration chamber, with a similar distance between each half carcass to avoid differences resulting from the circulation of air from the chilling process.

The chilling process was carried out for 24 hours with the chamber temperature adjusted to 0°C and air flow (ventilation) set at 0.5 to 3 meters/second. After the chilling process, the polyethylene stretch film was carefully removed from the half-carcasses selected for the use of the technique and same approach was used for all of the half-carcasses evaluated.

All half-carcasses selected to be used in this study were duly identified and weighed to obtain the hot half-carcass weight (hot-HCW) and then, after the process of chilling was complete and the film removed from the half-carcasses submitted to the chilling process with polyethylene film, each half-carcass was re-weighed exactly

after 24 hours of chilling process started, to obtain the cold half-carcass weight (cold-HCW), to then calculate the absolute and relative losses resulting from the chilling process.

The subcutaneous fat thickness was measured in the anatomic space between 12th and 13th ribs, above *Musculus longissimus*, with use of a digital caliper rule.

The experiment was carried out with an entirely randomized design, in a schema of subdivided parcels, considering the sexual type as parcel and the use of polyethylene film as sub-parcel. All of the data were analyzed using the PROC MIXED procedure from the Statistical Analysis System - SAS 9.0 (7), with the random effect attributed to the animal and 0.05 was adopted as the maximum tolerable limit for type I errors.

III. RESULTS AND DISCUSSION

The hot-HCW of steers and consequently cold-HCW were lighter ($P < 0.05$) than the non-castrated males, as shown in Table 1, without a difference between the adoption of the technique and the unobserved interaction. However, the subcutaneous fat thickness of the steers was greater than males ($P = 0.01$) in agreement with the results found by Pacheco et al. (3), because the non-castrated males have greater androgynous hormonal action that entails greater muscular development and less deposition of subcutaneous fat.

Table 1. Weight carcass, losses and subcutaneous fat according to sexual type and use of polyethylene film in Nellore animals

Parameters ¹	Sexual Type		Film		P		
	Steers	Male	Without	With	Sexual	Film	S*F
Hot-HCW, kg	133.4±2.3	141.6±2.1	137.8±1.6	137.2±1.6	0.0106	0.4982	0.2362
Cold-HCW, kg	131.7±2.3	140.1±1.9	135.8±1.6	136.0±1.6	0.0075	0.8307	0.4294
Losses, kg	1.82±0.27	1.87±0.24	2.26±0.21	1.43±0.21	0.9010	0.0003	0.0368
Losses, %	1.38±0.16	1.20±0.14	1.60±0.13	0.97±0.13	0.3933	0.0002	0.0268
SF, mm	6.62±0.66	4.25±0.62	5.29±0.53	5.58±0.51	0.0145	0.5718	0.0871

¹ HCW: half-carcass weight; SF: subcutaneous fat thickness.

The weight losses in the half-carcasses without the use of the polyethylene film did not change between steers and males beef cattle ($P>0.05$), in agreement with other research (Pacheco et al., 2013) that also did not find a difference between categories of the animals studied. But, an interaction effect between the sexual type and the use of the polyethylene film (Table 2) was observed ($P<0.05$).

Table 2. Interaction between sexual type and use of polyethylene film in beef half-carcass

	FILM	Steers	Male
Losses, Kg	Without	2.01±0.3Aa	2.51±0.3Aa
	With	1.64±0.3Aa	1.22±0.3Ba
Losses, %	Without	1.51±0.2Aa	1.69±0.2Aa
	With	1.24±0.2Aa	0.70±0.2Bb

Means in the same column, with different capital letters are significantly different ($P<0.05$).

Means in the same row, with different lower letters are significantly different ($P<0.05$).

The use of polyethylene film shows the effectiveness in the reduction in weight losses just in males, because, the weight losses in the steers without and with the use of film did not differ from one another ($P>0.05$), but the weight losses of males half-carcasses without and with the use of the film did differ ($P<0.05$).

The interaction effect can be explained by the differences in the carcass traits of the animals studied, mainly relating to the subcutaneous fat thickness, with difference in sexual type (Table 1). The males, in functioning of androgens hormone, have a thinner subcutaneous fat and a more developed anterior muscles of the body, mainly in the hindquarter, neck and chest, and thus greater meat production than steers (Rodrigues et al. 2003).

However, that trait does not entail a difference in weight losses when compared to steers without the use of the polyethylene film, as already observed in other studies such as that of Pacheco et al. (2013), given that these losses are the same, despite the differences among groups of animals studied after the chilling process.

The results of the weight losses in half-carcasses without the use of the film are different from other studies that show losses around 2% in the conventional chilling system. However, they are similar to values of 1.39% for losses in the conventional system and 1.54% in the forced air circulation process found by Mesquita et al. (8) and 1.55% in the control group and 1.36% in the group with the spray system found by Kinsella et al. (2).

However, the subcutaneous fat has an important function during the chilling process of every half-carcass, mainly in regard to the meat quality, because it serves as a protective barrier, avoiding surface evaporation and dehydration as well as excessive evaporation from the muscular tissues in the initial hours processing, responsible for the process of cold shortening (Savell et al. 2005).

The use polyethylene film in the male carcasses chilling is effective, in that the polyethylene film functions similarly to the coating of fat in regard to reducing the process of evaporation and dehydration of the carcass and subsequently results in the reduction of weight losses in the chilling process. Nellore males carcasses without the use of polyethylene film lost 1.69±0.17% while with the film loss 0.70±0.18%, an average difference ($P<0.05$) of one percentage point. Thus, the results of this work corroborated those of Sampaio (4), who also evaluated the use of polyethylene film in non-castrated male bovine carcasses and found a significant reduction in weight loss in carcasses wrapped in polyethylene film.

IV. CONCLUSION

The use of polyethylene stretch film reduces weight losses only in non-castrated Nellore carcasses with smaller subcutaneous fat thickness.

ACKNOWLEDGEMENTS

We thank Vale Grande Alimento LTDA for available the slaughterhouse for this work.

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