

# MICROBIOLOGICAL EVALUATION OF CARCASSES SURFACES AND STORED BEEF CUTS FOLLOWING SPRAY-CHILLING

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## I. INTRODUCTION

The greater or lesser acceptance of meat by consumers is directly affected by several factors related to livestock production and industrial processing. Spray-chilling system has been used in the USA and Canada, in order to reduce weight loss during chilling, which may reach almost 2%, resulting in an economical impact to the industry. It consists of a simple device made of PVC pipes with sprinkler nozzles organized side by side to the rails, inside the cooler. It works with intermittent spray of cold water in automated cycles pre-programmed. Total time of the program, time of spraying cycles and intervals between cycles can influence the weight loss. The efficiency of the spray-chilling system on reducing weight loss has been shown [1]. However, the water used on spray system and environmental conditions influence on carcass microbiota and therefore on microorganisms growing during storage, which may compromise safety and shelf life. It is therefore necessary to evaluate microbiological safety of using the spray-chilling system. The objective of this study was to evaluate the effects of a spray-chilling system on microbiological quality of carcasses surfaces and stored chuck tender beef (IMPS 116B) [2].

## II. MATERIALS AND METHODS

Twelve non-castrated bulls, were slaughtered according to the Brazilian Regulation. Carcasses were randomly assigned into two chilling treatments (n=6 carcasses for each treatment): conventional air chilling (CC) or spraying-chilling (SC), both of them during 24 h (2°C ± 1°C). The total spraying time for the SC treatment was 2 h (water temperature: 4°C), with the first cycle consisting of 180 s spraying, and subsequent cycles of 60 s spraying, always with 540 s interval. Approximately 1000mL of water from the spray-chilling was collected and submitted to the following microbiological analysis: total aerobic mesophilic counts (ISO 6222:1999), total and thermotolerant coliforms MPN [3]. Before and after chilling, 100 cm<sup>2</sup> samples from carcasses surfaces were collected using a 3M<sup>TM</sup> Hydrated-Sponges<sup>®</sup>, from three different locations (rump, loin and brisket), totalizing 300 cm<sup>2</sup> per carcass. After chilling, the *Supraspinatus* muscle, commercially named as “chuck tender” (IMPS 116B) [2] from six carcass sides from each treatment was deboned, individually vacuum packed and stored for 60 days at 0-2°C (n=6 beef cuts for each treatment). After storage, packed samples were aseptically opened, 25g were collected and placed into a sterile stomacher bag with 225 mL of buffered peptone water (1%) and homogenized for 60s. The microbiological analyses for carcasses surfaces and beef cuts were: detection of *Salmonella* spp. (ISO 6579-1:2017), enumeration of *Enterobacteriaceae* (ISO 21528-2:2017), psychrotrophic (AOAC 990.12) and *Escherichia coli* (AOAC 998.08). Bacterial counts were reported as the common logarithm of colony forming units/cm<sup>2</sup> (log<sub>10</sub> cfu/cm<sup>2</sup>). A nonparametric test (Kruskal-Wallis) was used for multiple comparisons.

## III. RESULTS AND DISCUSSION

The results for water analysis shown good microbiological quality, with 1.34 log<sub>10</sub> cfu/mL for total aerobic mesophilic counts and lower than 1.10 most probable number of total and thermotolerants coliforms. This indicates that no new microbial load was added on the carcass surfaces from spray-chilling treatment. Microbiological evaluation of carcasses (Table 1) shown low counts for *Enterobacteriaceae*, *Escherichia coli* and absence of *Salmonella* spp. in both treatments. Results for psychrotrophic were slightly higher,

although within acceptable limits. These indicate good microbiological quality, evidencing the use of suitable hygienic and sanitary procedures during slaughter and chilling, which may lead to a higher shelf life.

Table 1. Microbiological evaluation of carcass surfaces from spray-chilling and conventional air chilling treatments, before and after chilling (n=6 for each chilling treatment).

Treatment		<i>Enterobacteriaceae</i> (log <sub>10</sub> cfu/cm <sup>2</sup> )	<i>Escherichia coli</i> (log <sub>10</sub> cfu/cm <sup>2</sup> )	Psycrotrophic (log <sub>10</sub> cfu/cm <sup>2</sup> )	<i>Salmonella</i> spp. (absence/300 cm <sup>2</sup> )
SC	Before chilling	<1.0	<1.0	2.14	absence
	After chilling	<1.0	<1.0	2.46	absence
CC	Before chilling	<1.0	<1.0	1.07	absence
	After chilling	<1.0	<1.0	2.10	absence

SC: spray-chilling; CC: conventional air chilling.

Spray-chilling did not affect microbiological quality of beef cuts after storage, even though an increase on bacterial population was observed (Table 2). These results are similar to those reported by other authors [4, 5]. *Enterobacteriaceae* counts reached 3.24 log<sub>10</sub> cfu/cm<sup>2</sup> on SC samples and 1.74 log<sub>10</sub> cfu/cm<sup>2</sup> on CC samples. This bacterial family is commonly related to fecal contamination including deteriorating and pathogenic microorganisms. However, the results shown no counts of *Escherichia coli* and absence of *Salmonella* spp. Psycrotrophic population was considerably increased (> 5 log cycles) after storage time. This behavior was expected for this group due to the meat natural microbiota and storage conditions, which favors psycrotrophic growing. Microbiological, enzymatic and chemical transformations that result in meat deterioration can be considerably reduced by using adequate chilling and storage conditions, allowing longer shelf life.

Table 2. Microbiological evaluation of vacuum packed chuck tender beef cuts, stored for 60 days by chilling treatments (n=6 for each chilling treatment).

Treatment	<i>Enterobacteriaceae</i> (log <sub>10</sub> cfu/cm <sup>2</sup> )	<i>Escherichia coli</i> (log <sub>10</sub> cfu/cm <sup>2</sup> )	Psycrotrophic (log <sub>10</sub> cfu/cm <sup>2</sup> )	<i>Salmonella</i> spp. (absence/300 cm <sup>2</sup> )
SC	3.24	<1.0	7.28	absence
CC	1,74	<1.0	7.18	absence

SC: spray-chilling; CC: conventional air chilling

#### IV. CONCLUSION

When considering the evaluated conditions, spray-chilling system is a safe technique for using in order to reduce weight loss during chilling, without increasing meat bacterial spoilage. However, this safety is accomplished by a combination of good water quality, hygienic-sanitary processes and storage conditions.

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