EFFECT OF ELECTRICAL STIMULATION ON BEEF CARCASS DURING THE MATURATION PERIOD UNDER COMMERCIAL CONDITIONS IN URUGUAY

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I. INTRODUCTION

Foot and mouth disease (FMD) virus can survive in frozen meat in non-acidic environment; the presence of FMD virus in meat is considered a potential animal hazard [1]. FMD is a regional problem in South America and although Uruguay is presently categorized as free of FMD with vaccination, it must fulfill extra requirements during meat processing to export fresh prime beef cuts. These requirements establish that carcasses need to be maturated for 36 hours between 4 to 10 °C and the pH tested in the loin muscle must be less or equal to 5.8 to guarantee the inactivation of the virus [2].These conditions may pose a food safety risk since carcasses are maintained above 4 °C for at least 36 hours facilitating the eventual growth of pathogenic bacteria. The application of electric current on the carcass, used to improve meat tenderness, has the ability to accelerate pH decay in the muscle [3]. Its application after slaughtering could accelerate pH fall even at temperatures below 4 °C reducing the maturation period. The objective of this study was to evaluate the use of low voltage electrical stimulation (LVES) right after slaughter as a tool to accelerate pH decay and to study if the maturation conditions propitiate microbial growth on the carcass surface.

II. MATERIALS AND METHODS

Five hundred and forty three steers were randomly selected and assigned to one of these treatments: T1: Electrical stimulation, chiller temperature 4°C (n=111); T2: Electrical stimulation, chiller temperature 2°C (n=174); T3: No electrical stimulation, chiller temperature 4°C (n=109) and T4: No electrical stimulation, chiller temperature 2°C (n=149). The work was carried out in 7 different days in a commercial abattoir. Animals were mechanically stunned with a pneumatic air injection stunner; carcasses from T1 and T2 were electrical stimulated (40v, 1.5 amp) immediately after slaughter for 40 seconds using a JARVIS equipment. The time of the slaughter was considered time zero.

Measurements of carcass pH and temperature were made with a portable pH meter (HANNA 9025c) with FC 200 electrode and HI 7669/2W temperature probe. pH was measure by incision in the *l.dorsi* muscle (between 12th and 13th rib) at 4, 12, 16, 20, 24, 30 and 36 hs *post mortem* (pm). Carcass surface temperature was recorded with Hobo® data loggers whose sensors were placed underneath the surface of the hottest points of the anterior and posterior limb, previously determined using an infrared thermometer (UEi INF155). The carcass pH and surface temperature values of the hottest point, for both chiller temperatures, were used to generate predictive growth curves for *E. coli* O157:H7, *L. monocytogenes* and *Salmonella spp*. in the Pathogen Modeling Program (PMP) portals. The adaptation of the predictive model to variable temperature and pH was carried out as specified by the PMP portal. ANOVA and means analysis by LSD at 95% level of probability were done using IBM SPSS Statistics.

III. RESULTS AND DISCUSSION

The mean values for the carcasses side weight of each treatment were, T1:136kg; T2: 130kg; T3:135kg and T4:133 kg. Of the 543 carcasses 27 did not reach a pH value of 5.8 at 36 h pm, these carcasses had a pH value higher than 5.8 even at 60 hs pm. A similar proportion of carcasses with pH higher than 5.8 was observed in the risk analysis study performed by USDA [2]. Carcasses that had a pH below or equal 5.8 at 36 hs pm reached this condition at 20 hs pm regardless the treatment. The use of LVES immediately after slaughter decreased the proportion of carcasses with pH above 5.8 and accelerated muscle pH decline. T1 and T2 had significant ($p < 0.05$) lower values of mean carcass pH at 4 hs pm than those in T3 and T4 (5.7 and 5.8 for T1 and T2 and 6.1 for both T3 and T4). Final pH for all the treatments was 5.4. The observed

effect of LVES on the rate of carcass pH decline is in agreement with previous reported studies [3]. The *l.dorsi* mean temperature at 4 hs pm was 21°C for T1 and T3 and 22°C for T2 and T4. The cooling rate was similar for all the treatments until 12 hs pm, after this time T2 and T4 showed a faster cooling rate reaching a final temperature of 3°C significantly lower ($p < 0.05$) than 7°C, the temperature reached for T1 and T3. When chiller temperature was maintained at 4ºC carcass surface temperature at the hottest area was throughout the whole period above 9ºC, when the chiller temperature was adjusted to 2ºC surface temperature decreased faster reaching values of 5°C at 24 h. Predictive microbiology (Figure1) suggested that when maturation is done at chiller temperature above 4°C *E.coli* 0157:H7 and *Listeria monocytogenes* counts could double between 24 and 36 hs; not so *Salmonella*. However, if maturation is done at 2ºC, none of the pathogens studied could grow after 24 hours.

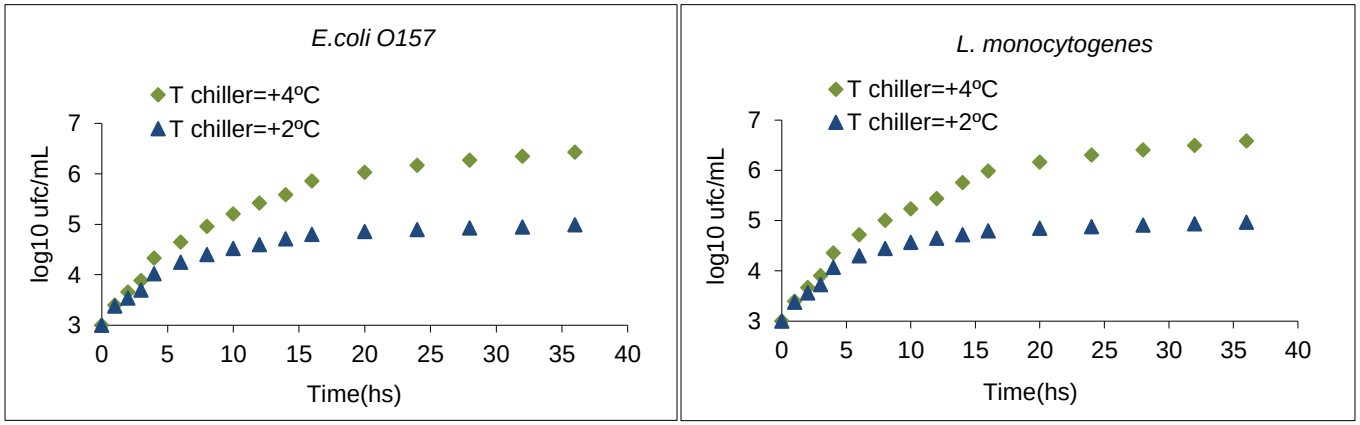

Figure 1. Predictive growth curves of pathogens studied.

IV. CONCLUSION

With the application of LVES right after slaughter, length and temperature of the maturation period could be reduced without increasing the risk for FMD transmission. This study suggests that maturation for 36 hours at 4°C is unnecessary and generates favorable conditions for pathogens to persist and grow on beef carcass surface.

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