MICROBIOLOGICAL AND SENSORY EVALUATION OF DIFFERENT TYPES OF MEAT FROM BEEF CARCASSES TREATED WITH LACTIC ACID

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I. INTRODUCTION

Hide removal and evisceration are the main sources of bacterial contamination of beef carcasses in abattoirs, since these could allow pathogens, which are possibly present on the skin or in the gastro-intestinal tract, to contaminate the carcasses [1]. Amongst the decontamination interventions applied on beef carcasses, lactic acid treatment (2 to 5%) was approved in Europe in 2013. Although bacterial reduction are expected to be lower than of two orders of magnitude with naturally contaminated beef carcasses [2, 3], the impact of lactic acid treatment on the shelf life of the carcass and different types of meat has scarcely been evaluated on commercial conditions [4, 5], and the overall interest of lactic acid treatment is questioned in France.

II. MATERIALS AND METHODS

A total of 105 sides of beef carcasses from different types of animals were sprayed just before chilling with a cold solution of 3% of lactic acid (LA) in a cabinet specifically designed for the project, over a 7-week period in a commercial abattoir. Both sides of each carcass (T for treated and C for control) were sampled for bacterial enumeration before treatment, 12 hours and 4 days post-treatment. T and C paired sides underwent visual commercial evaluation 1 and 4 days post-treatment by a jury of 4 meat professionals, and the defects type and extent were noted.

A limited set of 24 carcasses were further processed 4 days post-treatment: 16 forequarters were processed in ground beef patties (15% fat content) in 2 types of modified atmosphere packaging (MAP) of 30% O_2 with 70% CO_2 and 30% N_2 with 70% CO_2, respectively stored for 6 and 14 days at 4 °C; from these 16 carcasses, 8 hindquarters were deboned and insides of topside muscle were vacuum-packaged and stored 18 days at 2°C, then each muscle was sliced in 5 individual portions stored in standard meat tray with stretched film and stored 5 days at 4 °C; 8 striploins from Limousine cows were aged 11 days at 2 °C, then deboned and sliced in 5 steaks stored 4 days at 4 °C. All meats were sampled for bacterial enumeration at the beginning and the end of their shelf life and were sensory evaluated by an internal panel of 3 people at the end of their shelf life.

III. RESULTS AND DISCUSSION

Hot carcass spraying with a 3% solution of LA resulted in a limited but significant bacterial reduction of aerobic colony counts (ACC) of 0.7 $\log_{10}$ 12h post-treatment in comparison to C sides ($p<0.001$), *Enterobacteriaceae* counts were below the enumeration thresholds of 0 $\log_{10}$ cfu/cm². Four days post-treatment, ACC difference between T and C sides was still significant, but the average difference was limited to 0.3 $\log_{10}$ ($p<0.001$). These results are lower than generally reported [2, 3], but it must be noticed than the average initial ACC contamination was only 2.2 $\log_{10}$ cfu/cm². It also should be noted that the microbiological evaluation generally conducted within a few hours post-treatment may overestimate the bacterial reductions.

The visual commercial evaluation clarified the discolourations that are briefly mentioned in the literature [4, 6], which are superficially visible in the presence of blood (brownish) and fat tissues (yellowish). The intensity of these discolourations increased between 1 and 4 days post-treatment, and were more noticeable on forequarters than on hindquarters; this difference may due to the surface tissue composition, but the forequarters received a larger quantity of lactic acid during the carcass spraying. Half of forequarters treated with 3% of lactic were considered nearly commercially unacceptable according to professional criteria.

Most of these superficial defects disappeared during the standard deboning and cutting process of the quarters. The sensory evaluation performed at the end of the shelf life on the three types of meat processed, showed no difference on the criteria commonly used for meat evaluation (colour, odour, smearing, exudate…) between T and C meats. The impact of LA treatment on the carcass appearance should therefore be balanced
Although the bacterial contamination was significantly 0.3 $\log_{10}$ lower on ACC for treated carcasses 4d post-treatment, just before further cutting and deboning of sides, a non-significant difference of 0.2 $\log_{10}$ between T and C meats was also observed just after processing of ground patties for both type of MAP (p=35% for O_2/ CO_2; p=9% for N_2/CO_2); at the end of the shelf life the difference in ACC was lower than 0.1 $\log_{10}$. *Pseudomonas* counts (PSC) tended to be also lower after both packaging (-0.7 log, p<0.01; -0.3 log, p=8%), this difference was significant at the end of the shelf life of ground patties (-0.6 log, p<0.001; -0.4 log, p<0.01).
Vacuum-packaged topside meats presented 0.3 $\log_{10}$ lower ACC (p=6%) and PSC (p=12%) values just after packaging, but this tendency only remained for PSC (-0.2 log, p=12%) after 18 days. When sliced and placed in standard meat tray, a trend was also observed for PSC at the end of the 5d shelf life (-0.5 log, p=19%).
At the end of traditional butcher aging of Limousine striploins, no significant difference in ACC (-0.1 log, p=29%) and PSC (-0.2 log, p=59%) was observed just after deboning and slicing. But at the end of the shelf life on standard butcher paper, striploin steaks from treated carcasses had significant lower bacterial counts than those from untreated carcasses (ACC: -0.7 log, p=1%; PSC: -0.6 log, p=4%).
Despite the limited numbers of meat samples that could be followed up for the processing of T and C sides, the bacterial results showed a consistent and concordant trend with carcass results, for the 3 types of meats that were chosen for the evaluation of the impact of the treatment of hot carcasses with 3% of lactic acid.

IV. CONCLUSION

The efficacy of a 3% lactic acid spraying of hot beef carcasses was limited on commercial conditions, with a residual significant difference of 0.3 $\log_{10}$ in ACC between treated and control carcass sides 4d post-treatment. This bacterial reduction was much lower than expected [2, 3], but initial contamination of carcasses was low. Interestingly, this slight difference in bacterial numbers observed before deboning was persistently observed at the end of the shelf life of the different types of meat that were further processed, and was significant for *Pseudomonas* contamination of ground patties and striploin steaks, despite the limited numbers of samples.
Treatment with 3% of acid lactic induced some superficial visual modifications of the appearance of the carcasses, mainly visible in the presence of blood and on fat tissue, which were more noticeable 4 days post treatment and on forequarters than on hindquarters. However, no sensory differences were noticed at the end of the shelf life evaluation of the different types of meats processed with treated and untreated carcasses.
This evaluation on commercial conditions showed that lactic acid treatment of beef carcasses may be of interest for French beef meat industry to improve meat hygiene, but its consumer acceptance is questioned.

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