

EFFECTS OF TEMPERATURE ON THE GROWTH OF *E. COLI* O157:H7 IN DRY AGED BEEF

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I. INTRODUCTION

The control of process conditions in the production of dry-aged meat is crucial to the development of desirable sensory characteristics. In addition, process conditions must also be set to control the undesirable microbial growth, mainly pathogenic bacteria. *Escherichia coli* O157:H7 is one of the most important foodborne pathogens associated to beef consumption. This pathogen was associated with 87.8 % of the food outbreaks caused by beef consumption in the United States between 1980 and 2015 [1]. Temperature is a determining condition for the control of the bacterial growth. However, temperature conditions used for the processing of dry aged meat in commercial establishments vary greatly and, studies on the most suitable temperature conditions to inhibit the growth of pathogens in this type of product are limited. Therefore, the aim of this study was to assess the effect of temperature on the growth of *E. coli* O157:H7 in the production of dry-aged beef.

II. MATERIALS AND METHODS

A pool of four strains of *Escherichia coli* O157:H7 (0627. 0628. 0304. 0381) was grown in TSB broth (Tryptone Soya Broth – Himedia, Mumbai, India) at 37 °C for 24 h. Loin pieces (*longissimus thoracis and lumborum*) of approximately 1.5 kg from Nellore cattle were used. The bacterial pool was centrifuged and then, resuspended in saline solution. The volume for inoculation on loin pieces was calculated to achieve a population of approx. 5 log CFU/g. Pieces were spray-inoculated and randomly placed in aging chambers (Eletrofrio, Curitiba, Brazil) set at 0 °C; 3 °C and 7 °C. Air velocity and relative humidity were set at 2.5 m/s and 75%, respectively, for all treatments. The loins were aged for 40 days and at 0, 10, 20, 30 and 40 days, two pieces of each treatment were withdrawn for the count of *Escherichia coli* O157:H7. Microbiological count was carried out in samples collected from 5 different points of the inner and the outer portion of each loin piece, respectively. Enumeration was carried out on Sorbitol McConkey agar (Merck, Darmstadt, Germany) plates incubated at 37 °C for 48 h and results were expressed in log CFU/g. Data were analysed considering a mixed linear model including temperature (0, 3 and 7 °C) and storage time (0, 10, 20, 30 and 40) as fixed effects and replication as a random effect. ANOVA and Tukey test were used (P<0.05) for the data analyses.

III. RESULTS AND DISCUSSION

There was interaction between temperature and storage time for *E. coli* O157:H7 growth. Temperature showed a significant effect (P<0.05) on the count of *E. coli* O157:H7 in the inner portion of loin (Figure 1). Higher temperature showed greater growth of the pathogen. Over time, a significant decrease of the pathogen count was observed in all treatments. At the lowest temperature (0 °C), from 20 d, the count of *E. coli* O157:H7 was reduced to below the limit of detection (1.69 log CFU/g). At 3 °C and 7 °C the count of the pathogen showed a great reduction during the first 10 days of storage. After, *E. coli* O157:H7 population remained stable until the end of storage at 3 °C and showed a significant increase from 30 to 40 d at 7 °C. At the end of storage (40 d), the counts of *E. coli* O 157:H7 were <1.69, 2.44 and 5.90 log CFU/g in samples stored at 0,

3 and 7 °C, respectively. Therefore, a log reduction of >3.53 and 2.76 log CFU/g was observed in the inner portion of the beef aged at 0 and 3 °C, respectively. Conversely, at 7 °C, there was an increase of 0.6 log CFU/g on the count of *E. coli* O 157:H7 from 0 to 40d.

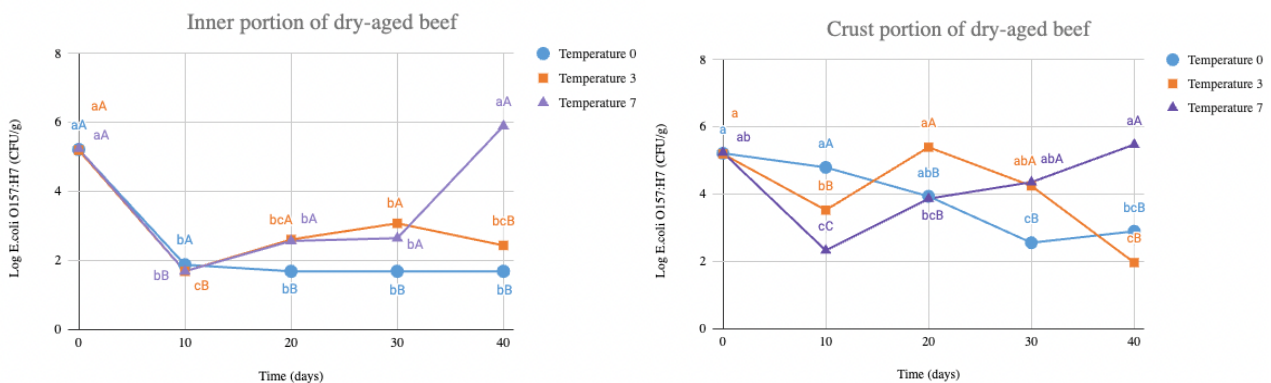


Figure 1 - Count of *E. coli* O157:H7 (CFU/g) in the inner portion (a) and in the outer portion (crust- b) of dry-aged beef loin aged at three different temperatures (0, 3 and 7 °C) for 40 days. ^{a,b} Different lowercase letters indicate differences between times. ^{A,B} Different uppercase letters indicate differences between temperatures. Limit of detection: 1.69 log CFU/g.

In the outer portion (crust), there was also a significant effect ($P < 0.05$) of temperature and time on the count of *E. coli* O157:H7. In all treatments, *E. coli* O 157:H7 count decreased on 10 d. At 0 °C, growth gradually decreased throughout time, whereas at 3 °C, a slight increase on 20 d was observed, followed by a decrease until the end of storage and, at 7 °C, growth behavior showed increase over time. For both, the inner and the outer portion, there was no significant difference in the number of *E. coli* O 157:H7 when aged at 0 and 3 °C on the last day of aging (40 d). Despite the growth control observed at 3 °C, the temperature of 0 °C was more effective on the reduction of *E. coli* O 157:H7 population to a safe level during aging process. In fact, temperatures lower than 3 °C were reported to control the pathogen in dry aged beef. In the studies of DeGeer et al. (2009) and Van Damme et al. (2022), the control and reduction of the population of *E. coli* and *E. coli* O 157:H7, respectively, was observed in dry aged beef at 2 °C.

IV. CONCLUSION

Among the different temperatures studied, 0 and 3 °C were effective for the control of the growth of *E. coli* O157:H7 during the process of dry-aging beef.

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