

Spoilage of vacuum-packed beef at different temperatures and pH conditions

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INTRODUCTION AND OBJECTIVE

The stability of the microbiological and the sensory quality of vacuum-packed beef constitutes a challenge for meat industries. Considering the significant role of Brazil in meat export world wide, the present work was developed to provide scientific data to explain the conditions that could influence the deterioration of Brazilian vacuum-packed beef and to develop predictive tools.

MATERIAL AND METHODS

In this study, the effects of temperature and initial pH of meat on the growth of lactic acid bacteria (LAB) and *Enterobacteriaceae* was investigated by using predictive modelling. The growth of these spoilage organisms was evaluated in vacuum-packed beef, coming from different meat cuts, namely, Trapezius thoracis, Longissimus dorsi and Psoas major, with an initial pH range of 5.4–5.8, 5.8–6.1 and ≥ 6.1 , that were stored at 0°C, 4°C, 7°C and 10°C. The primary model of Baranyi and Roberts (1994) was fitted to the microbial growth data using TableCurve 2Dv5.1. Subsequently, the maximum specific growth rate (μ_{max} , h⁻¹) was obtained for each experimental condition. A multiple linear regression analysis was used to characterize the significant factors affecting the square root transformed μ_{max} . The secondary square root model of Ratkowsky was applied to describe the effect of the temperature on μ_{max} .

RESULTS

LAB was the dominant spoilage population compared with *Enterobacteriaceae*. LAB reached levels between 7.0 and 8.0 log CFU/g in all studied conditions. Slightly lower and variable levels were found for *Enterobacteriaceae* and maximum concentrations ranged from 6.0 to 7.0 log CFU/g. The highest levels were associated with initial pH ranges 5.8 - 6.1 and ≥ 6.1 . As expected, both LAB and *Enterobacteriaceae* were positively influenced by the storage temperature and the initial pH (Figures 1 A and B).

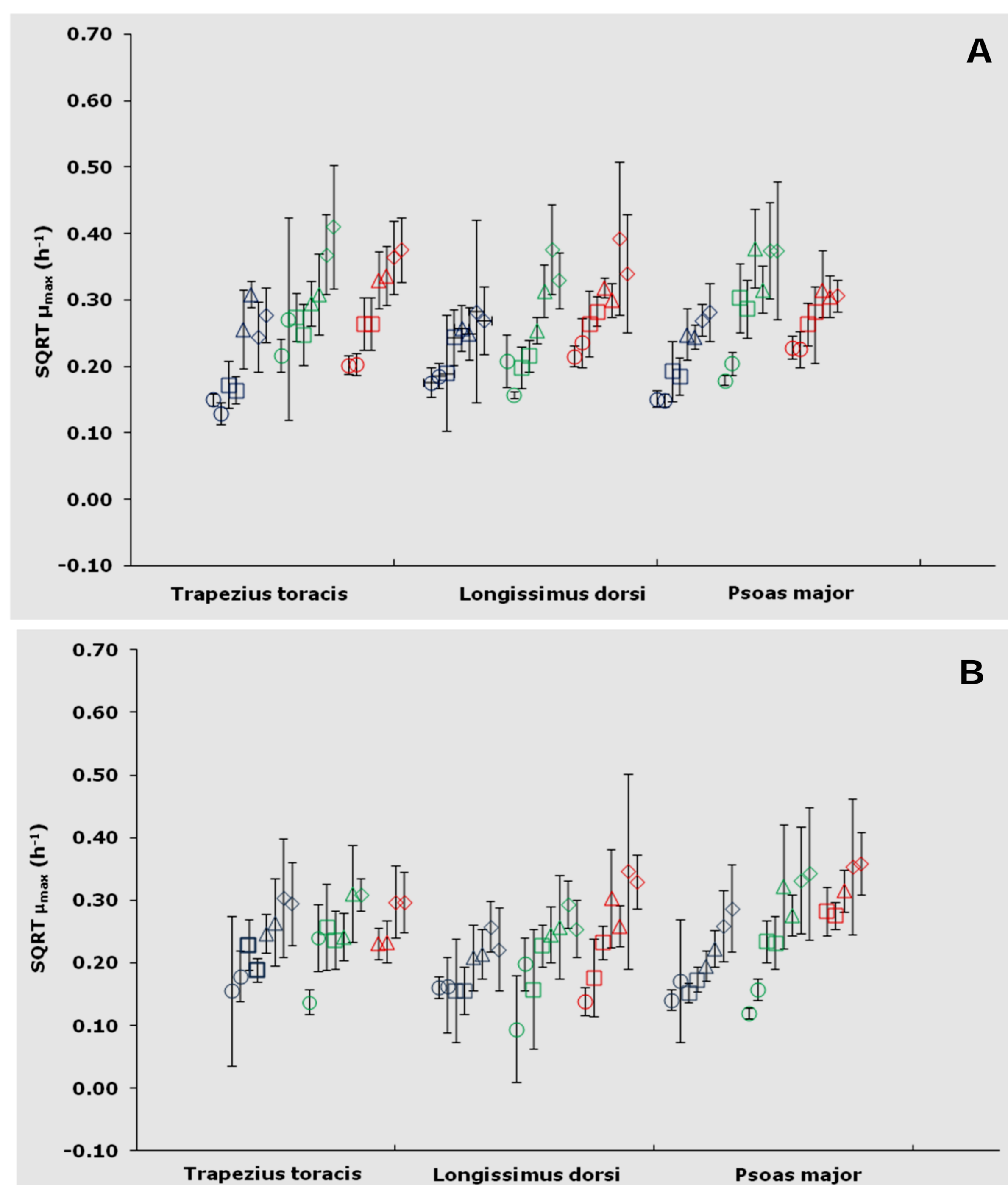


Figure 1. Maximum specific growth rate of LAB (A) and *Enterobacteriaceae* (B) at 0°C (○), 4°C (□), 7°C (△), and 10°C (◇) in vacuum-packed beef with initial pH range 5.4-5.8 (blue), 5.8-6.1 (green) and ≥ 6.1 (red).

The multiple linear regression analysis supported these results, where both the temperature and the initial pH had a significant effect on μ_{max} of LAB and *Enterobacteriaceae*, with the effect of the temperature being higher than the initial pH. The effect of initial pH was characterized as follow: pH 5.4-5.8 < pH 5.8-6.1 = pH ≥ 6.1 .

The type of meat cut was not a significant factor affecting LAB growth. In the case of *Enterobacteriaceae*, the μ_{max} values were significantly different in Longissimus dorsi compared to those values estimated in Trapezius toracis and Psoas major, with an effect of Longissimus dorsi > Trapezius toracis = Psoas major.

The effect of temperature on μ_{max} of LAB (A) and *Enterobacteriaceae* (B) is shown in Figure 2.

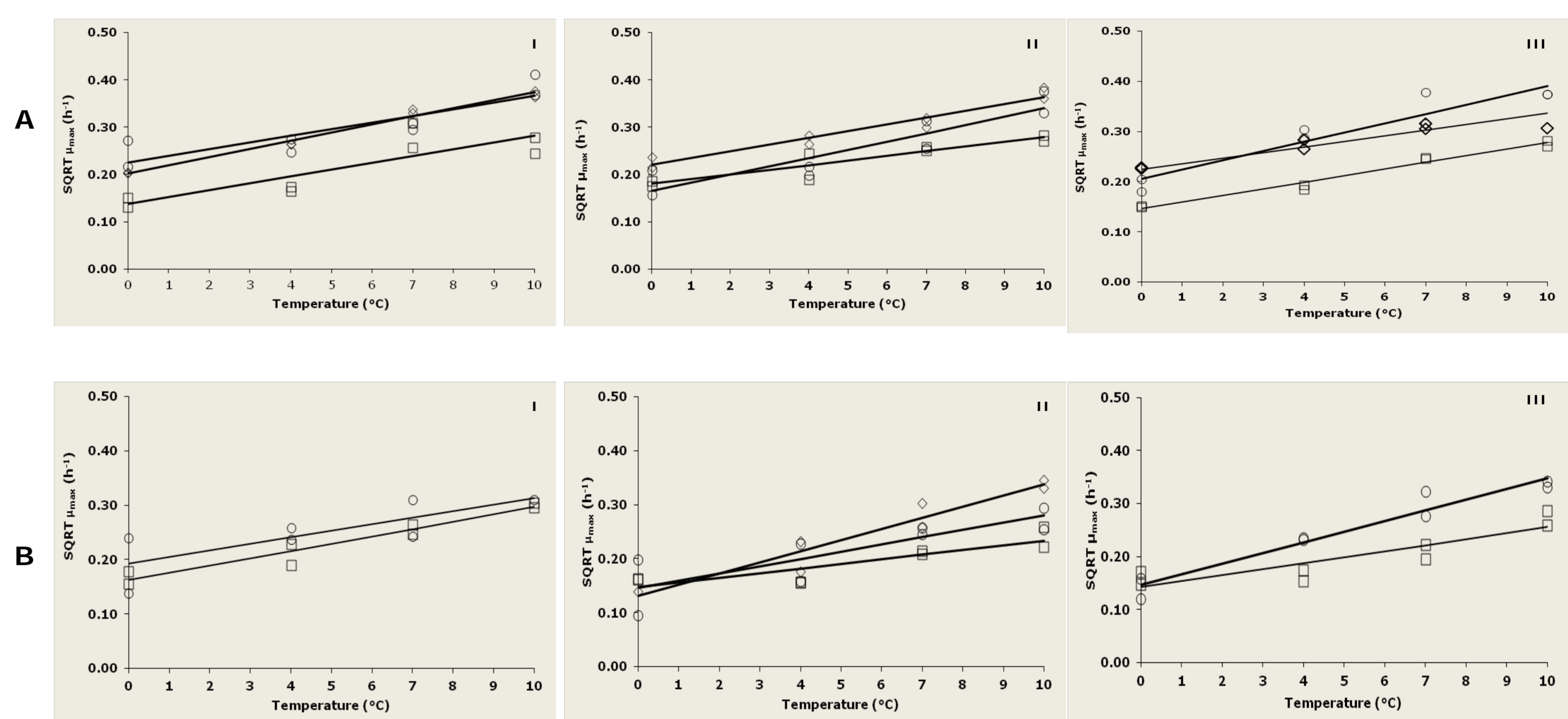


Figure 2. Maximum specific growth rate of LAB (A) and *Enterobacteriaceae* (B) in Trapezius toracis (I), Longissimus dorsi (II) and Psoas major (III) with initial pH 5.4-5.8 (□), 5.8-6.1 (○) and ≥ 6.1 (◇) at 0°C, 4°C, 7°C and 10°C, modelled by Ratkowsky model (solid line).

The parameters of the model were calculated, and in case of LAB, the b values ranged from 0.009 h^{-1/2} °C⁻¹ (95% CI: 0.006-0.014) to 0.018 h^{-1/2} °C⁻¹ (95% CI: 0.012-0.025). The T_{min} values varied between -9.5°C (95% CI: -16.4 to -2.7°C) to -20.0°C (95% CI: -30.0 to -9.9°C).

The b values of *Enterobacteriaceae* ranged from 0.008 h^{-1/2} °C⁻¹ (95% CI: 0.004-0.013) to 0.022 h^{-1/2} °C⁻¹ (95% CI: 0.019-0.024). The T_{min} values varied between -3.8°C (95% CI: -4.9 to -2.6°C) to -17.6°C (95% CI: -21.5 to -13.8°C). These parameters tended to increase at higher initial pH values, being more evident on Longissimus dorsi.

CONCLUSIONS

The storage temperature had a significant effect on the growth of the studied spoilage populations.

The type of cut had a significant effect on the growth of *Enterobacteriaceae* being more evident on Longissimus dorsi.

The initial pH of meat affected the growth of LAB and *Enterobacteriaceae* since a lower μ_{max} was noted at initial pH 5.4-5.8.

ACKNOWLEDGEMENT

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