

Evaluation of *Salmonella enterica* behavior in hummus under different temperature conditions

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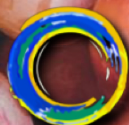
Hummus is a ready-to-eat (RTE) food made from cooked chickpeas, olive oil, lemon juice, tahini, salt, and water, and has been widely consumed worldwide. However, during the production process, contamination by pathogenic microorganisms such as *Salmonella enterica* can occur. Therefore, this study assessed the behavior of three serotypes of *Salmonella enterica* in hummus paste stored at different temperatures. The hummus was prepared under aseptic conditions, following a traditional formulation. After preparation, three strains of *Salmonella* (*S. Senftenberg*, *S. Typhimurium*, and *S. Enteritidis*) were inoculated individually into the hummus at ca. of 3 log CFU/g and then stored at 4, 7, 10, 12 and 15 °C for 10 days. Potential growth (δ) was calculated for each of the *S. enterica* strains through the difference between the maximum observed and initial counts. Additionally, the Baranyi and Roberts (BAR) model was used to obtain the kinetic parameters of growth, including lag time (λ ; h), maximum specific growth rate (μ_{\max} ; h⁻¹), and maximum population density (N_{\max} ; log CFU/g), while the Weibull model was used to obtain the time for first decimal reduction (h). Both models were applied to each of the three strains of *Salmonella*. The δ values ranged from 6.17 to -1.33, 6.28 to -2.88, and 6.07 to -1.74 log CFU/g for *S. Enteritidis*, *S. Typhimurium*, and *S. Senftenberg*, respectively, within the studied temperature range. The estimated μ_{\max} for the *Salmonella enterica* strains in hummus at 10-15 °C, fitted by the BAR model, ranged from 0.013 to 0.205 h⁻¹. The λ for the pathogen strains stored within the temperature range varied from 9 to 98 h. However, at 12 °C, no λ was observed for any strains. The *S. Senftenberg* was the fastest strain, with $\mu_{\max} = 0.205$ h⁻¹ when the product was stored at 15 °C, meanwhile the lowest μ_{\max} was observed for the same serotype when stored at 10 °C, with a $\mu_{\max} = 0.013$ h⁻¹. All tested strains achieved N_{\max} values >7.0 log CFU/g at temperatures ranging from 10 to 15 °C. At 10 °C, the *S. Enteritidis* strain exhibited the highest μ_{\max} of 0.074 h⁻¹ and longest λ , which was 98 h. For storage temperatures of 4 and 7 °C, the pathogen's survival in hummus can be observed, resulting in decimal reduction times ranging from 15.9 to 167.5 h. The highest value for decimal reduction corresponded to the *S. Senftenberg* strain (167.5 h) when the hummus was stored at 7 °C. However, the smallest reduction was observed in the *S. Typhimurium* (15.9 h) strain when stored at 4 °C. At refrigeration, abuse temperatures (15 and 12 °C) and at 10 °C, the growth of *S. enterica* in hummus increased. Meanwhile, at lower storage temperatures (4 and 7 °C), *S. enterica* survived in the food. The estimated parameters can be useful in assessing the shelf life of product and establishing measures to control the growth of the pathogen.



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