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Development of a predictive model for the growth of *Listeria monocytogenes* in fresh goat cheese "*Jben*" under varying temperature conditions

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INTRODUCTION & AIM

Ready-to-eat cheeses, such as *Jben*, can be contaminated by *Listeria monocytogenes*, a bacterium resistant to refrigeration conditions and hazardous to vulnerable populations. This study develops predictive models specifically adapted to goat's milk *Jben* to evaluate and control the behavior of *L. monocytogenes* under storage conditions, thereby contributing to improved microbiological safety of this traditional cheese.

METHODOLOGY

Production of goat's cheese

Goat's milk *Jben* was prepared in the laboratory from boiled milk coagulated with calcium chloride and rennet, without the addition of a starter culture. After salting and aseptic portioning into 10 g samples, each portion was inoculated with a *L. monocytogenes* cocktail (10^2–10^3 CFU/g) using a deep contamination method, then stored at different temperatures for microbiological monitoring over 20 days, with non-inoculated samples serving as controls.

Enumeration of *L. monocytogenes* and LAB and determination of pH and aw

Microbiological analysis of *Jben* samples was carried out after inoculation and at various intervals depending on the storage temperature. The samples were diluted and homogenized in sterile saline solution, then plated on Oxford agar for enumeration of *L. monocytogenes* (ISO 11290-1/2) and incubated at 37 °C for 48 h. Lactic acid bacteria were counted on MRS agar after incubation at 30 °C for 48 h. Two inoculated samples per temperature were analyzed at each sampling point. The pH and aw of the control samples were measured periodically during storage.

Modelling

Primary model

The primary model of Baranyi and Roberts was implemented in MATLAB to fit the kinetic data and determine microbial growth parameters, such as (μ_{max}), (y_{max}), and lag time, at different temperatures.

$$y(t) = y_0 + \mu_{max}A(t) - ln\left(1 + \frac{exp^{\mu_{max}A(t)} - 1}{exp^{(y_{max} - y_0)}}\right)$$

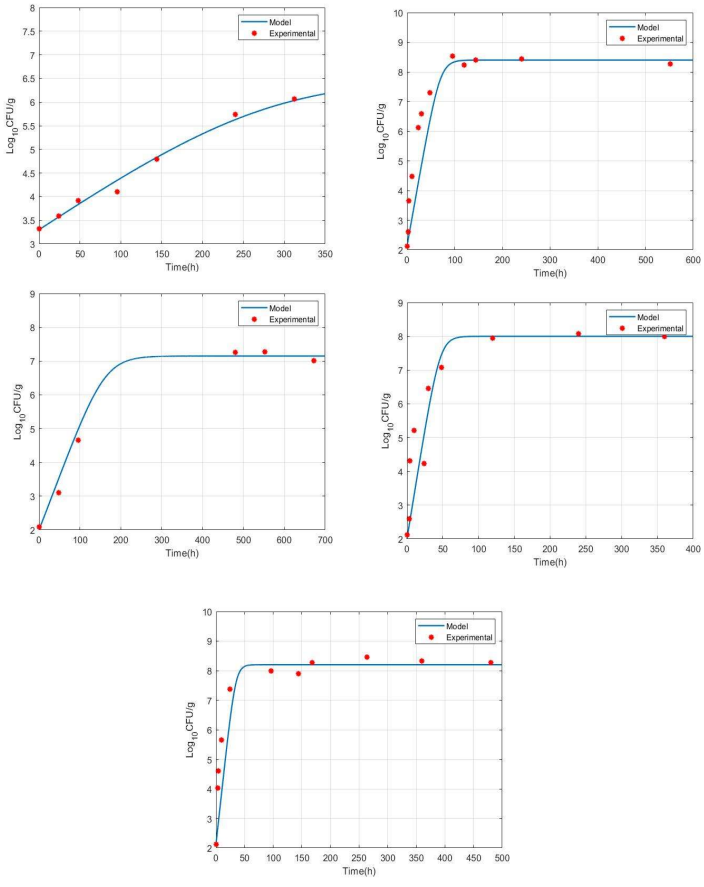
Secondary model

The Ratkowsky model relates temperature to the maximum growth rate (μ_{max}) of microorganisms.

$$\sqrt{\mu_{max}} = b(T - T_{min})$$

RESULTS & DISCUSSION

Listeria monocytogenes demonstrated its ability to survive and grow during the production and storage of *Jben*. The study highlights the importance of temperature control and compliance with sanitary standards to prevent contamination, while confirming the reliability of the Baranyi and Roberts model in describing its growth.



Primary models obtained from the growth curves of *L. monocytogenes* in *Jben* at (a) 4°C, (b) 10°C, (c) 20°C, (d) 25°C, and (e) 30°C.

CONCLUSION

The study highlights the usefulness of mathematical models in predicting the growth of *Listeria monocytogenes* in *Jben* between 4 and 30 °C, emphasizing the need for strict temperature control and good hygiene practices to ensure product safety.

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