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CARDINAL PARAMETER MODEL CONTAINING A NEW NISIN TERM TO PREDICT GROWTH OF *LISTERIA MONOCYTOGENES* IN PROCESSED CHEESE

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Introduction: Nisin is a preservative with a well-documented use for the control of sporeforming bacteria in processed cheese. However, little information is available with regards to its protective effect against pathogens such as *Listeria monocytogenes*, when introduced in processed cheese by cross-contamination at the consumer phase.

The objective was to develop a mathematical model to predict growth of *L. monocytogenes* in processed cheese containing added nisin.

Methodology: Minimum inhibitory concentration (MIC) values for nisin were determined experimentally in broth at pH 5.5 and 6.0 and collected from literature at different pH values. A polynomial MIC-function was developed to describe the effect of pH on nisin MIC values. Two existing growth and growth boundary models were expanded with the new MIC-function for nisin to predict growth of *L. monocytogenes* in chemically acidified cheese and processed cheese. To generate growth data for model evaluation, challenge tests (n=45) were performed with *L. monocytogenes* inoculated in chemically acidified cheeses and processed cheeses containing added nisin (0-25 mg/kg). A LC-MS/MS method was developed and validated to quantify nisin A and Z in cheese.

Results: The nisin recoveries ranged from 83 to 110 % for nisin A and from 95 to 113 % for nisin Z. The limits of detection and quantification for both nisin A and nisin Z were 0.04 mg/kg and 0.12 mg/kg, respectively. Applicability of the LC-MS/MS method was tested by analysing 13 different cheeses containing nisin. Five cheese samples contained nisin A at concentrations in the range from 0.16 to 0.19 mg/kg. Evaluation of the model by comparison of observed and predicted growth rates resulted in bias and accuracy factor-values of 1.02 and 1.12 for a total of 18 growth responses in processed cheese. Further studies with higher concentrations of nisin will be beneficial to validate the new nisin MIC-function including the effect of pH on nisin MIC values.

Conclusions and relevance: The developed model can be used to support product development, reformulation or risk assessment of processed cheeses containing nisin A.