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Minimizing the risk of foodborne illness and analytical costs using a QMRA model for raw milk cheeses.

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Introduction: The contribution of this work is twofold. Firstly we propose an extension to the Quantitative Microbiological Risk Assessment (QMRA) model proposed by Perrin et al (2014), which is today used by dairy professionals in France, for optimizing microbiological sampling plans regarding the risk of Haemolytic and Uremic Syndrome (HUS), caused by Shiga-toxin producing *Escherichia coli* (STEC). Secondly, we use this QMRA model to establish efficient bio-intervention strategies or more specifically to find optimal process intervention parameters for minimizing the risk of the illness and the associated cost of intervention. This translates into a multi-objective optimization problem of a stochastic simulator.

Methodology: The newly proposed multi-pathogens model incorporates the effects of two more pathogenic bacteria namely *Salmonella* and *Listeria monocytogenes*, which can occasionally be present in raw milk. This model accounts for, pathogen prevalence and concentration among farm animals, and the growth and decline rates of the micro-organisms in the cheese matrix. Risk for the three pathogens is assessed by combining exposure and dose-response models. The overall risk is assessed by combining the burden of disease metrics (a.k.a Disability Adjusted Life Years) for the three pathogens. For optimization we rely on Bayesian methods, in particular, we propose a modified version of the PALS algorithm (Pareto Active Learning for Stochastic simulators) by Barracosa et al (2021), to estimate the Pareto optimal solutions for the intervention parameters.

Results: We have considered the problem of minimizing the risk of illness and the cost of the associated interventions, in order to find the optimal parameters namely, the frequency of milk testing, the milk testing threshold, the proportion of batches tested for cheese, and the sample size for testing.

Conclusions and Relevance: The objective of the study is to optimize the potential control measures available for minimizing the risk of foodborne illness from the consumption of raw milk cheeses and make recommendations to dairy professionals.

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