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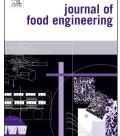
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## **Analysis and Model-based Optimization of a Pectin Extraction Process**

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## 1 Abstract

2 Raw material quality disparity is an unavoidable and systemic variability in the solid-liquid extraction process of pectin manufacturing. A mathematical model is considered for a robust optimization of the 3 4 process, taking into the account raw material quality uncertainty, for two different scenarios of pectin 5 product quality profiles. Before application, the model is evaluated through local sensitivity analysis. Raw 6 material-specific parameters and non-significant parameters are removed from the parameter set targeted for identification. Furthermore, it is shown that the model outputs are highly sensitive to the peel specific 7 parameters, which inherently vary from peel-to-peel. This impact was further assessed through an 8 9 uncertainty analysis, which quantified the variability of model predictions due to the raw material 10 parameter uncertainty for three different types of fruit. The model exhibits a good general depiction of the 11 extraction phenomena. Major operating variables, i.e., temperature, pH and batch time, are optimized in a 12 deterministic manner for each fruit to maximize the final pectin concentration while satisfying given 13 requirements. Based on this, a robust optimization strategy is examined to design an optimal operation 14 strategy in consideration of the inherent uncertainty of feedstock and the desired product quality. Keywords: Pectin; Solid-liquid extraction; Model-based optimization; Model analysis 15

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