Miacro: A Reverse-Engineering Framework for Non Invasive Carcinogenic Acrylamide Removal Using Predictive Neural Networks to Rectify Industry Procedures for Sustainable, Next Generation Consumer Health

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Carcinogenic acrylamide naturally forms in common foods and drinks containing asparagines and reducing sugars when processed at temperatures above 120°C. Recent worldwide concern for consumer safety measures is underway, yet, the commercial food industry has yet to discover a mitigation procedure that counteracts the majority of this Maillard reaction without altering sensory properties or presenting new health concerns. Hence, the present research focuses on developing a non-invasive removal procedure for instant coffee by exploiting acrylamide's low molecular weight and glass transition state. By properly modulating processing conditions to maximize acrylamide removal while minimizing volatile loss, I discovered the optimal thermodynamic conditions that facilitate the sublimation, and thus, removal of water content and the majority of acrylamide concentration from instant coffee. A novel reverse engineering framework is developed using various regression models trained after experimentation with several hundred LC/MS/MS results. Repeated experiments validated proposed calculations with remarkable predictive capability as R2 = 98.2% of the variance for calculated removal values are accounted for. Such results elucidate the requirements for scaling the method to industrial instant coffee manufacturing procedures. The Miacro framework can search for the optimal processing parameters that satisfy a target acrylamide removal specification for the industrial freeze-drying phase.

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