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## Digital tools for efficient food manufacturing: For the community by the community

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Computer-aided engineering tools accelerate product and process design through reduced trial and error but such tools appropriate for the food industry have been slow to develop. Uniqueness, complexity, and variability of food materials and processes greatly contribute to this tool scarcity. Here we showcase two easy-to-use digital tools/platforms for efficient product and process design that can aid the most common product/process design issues, are freely available, and grow with community contributions.

The first of these tools is a food properties knowledge base where the user can easily and quickly estimate the properties of almost 10,000 food materials. In addition to obtaining quick data, such effortless visualization allows comparison of multiple materials for a property, multiple properties of the same material, and composition and temperature effects, leading to a materials science understanding in a discovery mode. The knowledge base is hosted using a relational database that stores property information either as algebraic formulas or a table of data points, and a convenient user interface to search, estimate, and visualize. The knowledge base has in-built crowdsourcing with quality monitoring so it can grow with community contributions.

The second resource is a repository of accurate and robust numerical models of important food processing operations, to be shared among the design, research, and education communities. Easy availability of these models through the repository, with their advantages of quick “what if” scenarios and a vastly improved mechanistic understanding, will propel the community faster toward simulation-based design of food products and processes. For example, one of the first entries in this repository, from our research group, is a dynamic deep learning framework-driven surrogate of a computationally expensive mechanistic model simulating convective drying. We expect this repository to be the go-to place for downloadable codes as well as online applications. The needed infrastructure that ensures quality is currently being finalized.

The two tools presented here cover a large area of food applications and cover industrial design, academic and industry research, and education. Built-in crowdsourcing ability, allowing growth with community contributions, should be a game changer in making computer-aided food engineering a reality.