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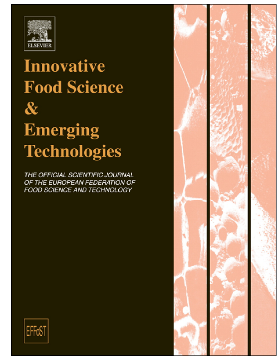
DRY biorefineries: Multiscale modeling studies and innovative processing



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DRY biorefineries: multiscale modelling studies and innovative processing

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Abstract

This paper reviews studies on green resource fractionation for two different types of material displaying a lignocellulosic or granular-type structure or a composite of the two. It explains how the identification of specific biochemical or spectral markers helps monitor tissue fate along processing and thus increase our knowledge on material fractionation. The key role of tissue mechanical properties in fracture behavior and the value of characterizing them were highlighted to better understand particle composition and properties. The effect of different modes of mechanical stress and strain during grinding as the main step of fractionation was illustrated. The value of different types of pre-treatment before or at grinding to reduce energy required to fracture and enhance dissociation or compound accessibility was presented. Separation methods based on differences in properties of the generated particles, and particularly innovative developments based on electrostatic sorting, were reviewed.

1 Introduction

Dry biorefining emerges as the most appropriate processing technology to help develop products (food, packaging, bio-chemicals, energy, etc.) made with renewable resources in a sustainable chain. Dry biorefining helps economize water and avoids energy consumption in drying operations. It is traditionally undertaken to convert cereal grains by grinding them into particles (between 30 and 1500 µm) ready to be further classified by sieving. Depending on their biochemical composition and specific properties, these particles are used to make cereal products like bread, pasta, semolina or biscuits or to serve for feeds or production of energy. Plants material is a heterogeneous structure made of distinct organs (stem, grains, leaves, etc.), each composed of different tissues with specific composition and structure. The way they break under process stress will thus determine the composition of the particles produced. Moreover, a heterogeneous particle can be transformed into a homogeneous one if its size is sufficiently reduced by grinding. This will open the way to tissue or even molecular isolation. The fracture behavior of the raw material or its component tissues depends on its mechanical properties, which can be characterized and are related to the material's structure and biochemical composition. This makes it important to gain better knowledge of the raw material fracture behavior in order to better understand and further control the biochemical composition and