16 Numerical Modeling of Morphological Changes of Food Plant Materials during Drying

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16.1 INTRODUCTION

Food plant materials, particularly fruits and vegetables, when undergoing drying are subjected to higher levels of morphological changes, leading to alteration of various physical properties characterizing the dried food product. The main factors driving such morphological changes are the moisture content, drying temperature, atmospheric conditions, rate of moisture removal, and properties of the food plant variety. Prediction of such morphological changes is critical for improving the product quality and processing efficiency in food engineering. In that context, different modeling techniques are being researched, each having its own pros and cons depending on the fundamental nature of the technique and its level of advancement achieved, targeting a given application. Among these modeling techniques, numerical modeling has gained considerable attention since the recent past, and which holds true for the present too. In this background, this chapter initially presents an overview of the different modeling techniques used in the field, and then it specifically presents a novel numerical modeling technique available its key applications, limitations, and future prospects.

16.1.1 Characteristics of the Cellular Structure Existing in Food Plant Materials

Food plant materials are essentially made out of cells aggregated to form tissues. In those plant tissues, cells are mainly composed of two elements: cell fluid and cell wall. Cell fluid usually accounts for about 80%–90% of the whole cell's volume or mass. Cell fluid is mainly occupied by vacuole, which is basically a large storage of watery liquid constituents (Jangam 2011). The cell wall is a thin porous layer mainly composed of microfibers and has viscoelastic properties. The cell wall acts as a boundary to ensure the cell fluid is contained within the cell volume. When the food plant materials are in fresh conditions, cells tend to be in their fully turgid states, having higher turgor pressure values owing to the higher