Measurement of bread crumb texture via imaging of its characteristics

ABSTRACT

A simplified image processing method has been designed based on a two-dimensional scanned red, green and blue (RGB) colour image model to evaluate bread crumb characteristics using commercially available image processing software. This method is completely objective in all respects, and highlights a minimal basic imaging method with the adaptation of an automatic threshold segmentation technique based on a statistical clustering approach. The typical spatial resolution used was approximately 85 µm2 crumbs per pixel and the cell detection sensitivity was up to 94 µm in diameter. The image processing time to compute the crumb cell structure for a single bread slice with 422,500 pixels per image was about 2 seconds. The image analysis was evaluated accurately by the results of the individual cell characteristics including the total cell count, cell area, and cell average diameter to derive crumb fineness, void fraction and cell uniformity for four types of different breads, i.e. closed and open lid sandwich loaves, country white bread and the baguette. The cell-total area ratio was found to increase across the four bread types from the closed sandwich (22%), open sandwich (29%), country (35%) and baguette (42%). This is consistent with visual observation of the crumb cell structures. The imaged crumb characteristics of the void fraction is well correlated with the physical crumb texture of the bread density at $R2 = 0.8422$ while crumb fineness and cell uniformity both show a positive correlation with the bread texture measured by its firmness at $R2 = 0.633$ and $R2 = 0.6876$, respectively. The results support the theory on the influence of cell size and distribution on bread texture.

Keyword: Image processing; Bread crumb structure; Bread texture; Bread characteristics