



Topical Research Meeting on Physics in Food Manufacturing

Session: Ingredients

Mechanisms of bubble structure formation in bread and cakes

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Bread and cakes have an aerated sponge structure that confers a soft texture. Gas bubble nuclei are created during mixing and expand due to carbon dioxide production during proof and baking to form a foam. Later in baking, the structure sets and the bubbles interconnect to form a sponge.

Imaging methods have been used to study structure formation and the role of ingredient properties and process conditions. Bubble size distributions in freshly mixed dough have been measured by microscopy and those in bread have been measured using the C-Cell imaging system, originally developed by the author. Additional measurements of 3D structure have been made by X-ray micro tomography. Development of structure during production has been imaged dynamically for full-scale bread and cakes proved and baked inside a medical X-ray CT scanner.

The effects of recipe and process variations are presented. Headspace pressure during dough mixing controls the number of gas cell nuclei created and the resulting bread structure. Gas retention during proof is affected by dough rheology, including strain hardening, dependent on flour properties and gluten development in mixing. The effect of lipids on stabilisation of bubbles during baking is also presented. For cakes, mechanisms are presented for several distinct structures, including convection in a high ratio cake batter and the formation of tunnel holes in muffins. Measurements of batter structure, pressure and temperature during baking have been used to identify foam to sponge conversion. The causes of some faults in product structure are also presented.