

Biscuit Checking Club Proposal

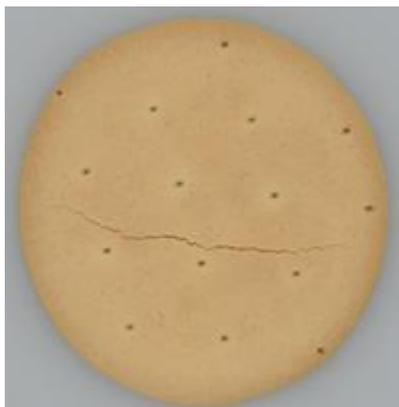
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Aim

To provide a better understanding of the factors that cause checking of biscuits and crackers. Thus, to predict when checking is likely to occur and ultimately to identify strategies to prevent it.

Background

Checking is a major quality issue for manufacturers of biscuits and crackers. Broken products can be rejected by retailers and are a cause of customer complaints and damage to brand reputation. Despite this, the underlying mechanisms and conditions that lead to checking are poorly understood.



Previous research in collaboration with Campden BRI used experimental and numerical methods to produce a computational model^{1 2}. The work showed that, at particular relative humidities, the rim of the biscuit expands and the centre contracts. This was modelled by uptake of moisture at the rim, which is initially dry after baking, and the contraction was attributable to loss of moisture from the centre.

Little work has been published in this area in the intervening ~15 years and yet checking remains a problem. Advances in analytical and modelling capabilities at Campden BRI provide ideal facilities for further research to deliver a more detailed understanding of checking and to support club members in its control. Facilities include pilot baking, hyperspectral NIR imaging equipment for mapping moisture distribution and finite element modelling for computational simulations.

Potential areas of study

This project will study the effect on checking of ingredients, product geometry, baking, cooling and storage conditions. It will seek to identify the mechanisms that lead to checking and thereby to propose approaches for its prevention. A computational model will be developed that simulates cooling, moisture migration and the resulting stresses and strains. Experimental measurements will be made of moisture migration and for product characterisation.

The following will be studied experimentally and modelled computationally:

- Formulation and ingredient properties such as the role of gluten development, moisture absorbing ingredients such as starch and cocoa, and novel ingredients (e.g. for fat/sugar replacement)

¹ Saleem, Q., Wildman, R. D., Huntley, J. M. and Whitworth, M. B. (2005). Improved understanding of biscuit checking using speckle interferometry and finite-element modelling techniques. *Proc. R. Soc. A* **461**, 2135-2154.

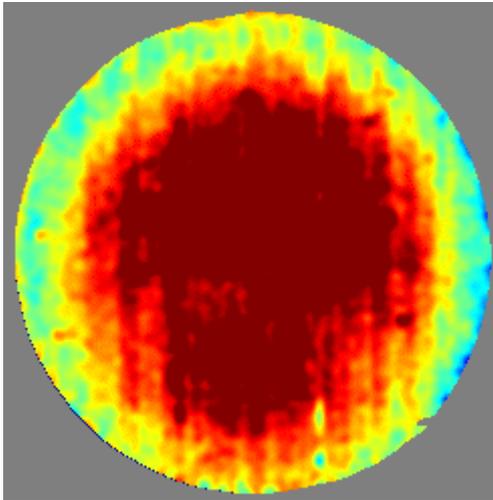
² Saleem, Q., Wildman, R. D., Huntley, J. M. and Whitworth, M. B. (2003), Understanding biscuit checking by speckle interferometry and finite element modelling. Campden BRI R&D Report 186.

- Mechanical properties (texture)
- Product geometry, such as thickness, products with 'corners' and the location of docking holes
- Baking (oven conditions), cooling, storage and packaging

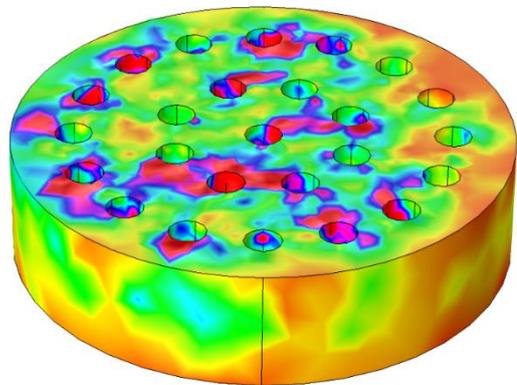
Experimental methods

- Test baking and controlled environments for cooling and storage
- Hyperspectral NIR imaging of moisture distribution
- Computational modelling
- Extensive analytical facilities for characterisation of flour and other ingredients
- Product characterisation methods including texture analysis, X-ray micro CT for analysis of porosity and structure, and measurement of product dimensions such as stack height

Moisture distribution map of a semi-sweet biscuit measured 15 mins after baking



Finite element model showing stress in a biscuit



Benefits to partners

Improved product quality leading to fewer rejected products and fewer complaints from customers. This will be achieved through an increased understanding of the mechanisms that lead to checking and practical advice about how to identify and mitigate potential causes of checking.

Who should join

The project is suitable for manufacturers of biscuits, crackers and other products that are affected by checking. We would also welcome collaborations with suppliers of bakery ingredients, processing equipment and analysis instruments.

Project structure

This pre-competitive project will be run as an industrial club, to be funded and steered by a private consortium of interested parties. The project will be subject to a consortium agreement covering issues such as confidentiality and ownership of arising intellectual property.

Duration

- 3 years
- Target start date: 1st March 2019

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