“Advances in Bakery Research”

Dr Steven Walker *Printer *** Insert photo of Dr Steven Walker*

In this presentation, I would like to discuss why R&D is important and give some examples of the work undertaken at Campden & Chorleywood Food Research Association (CCFRA). As part of this, a brief introduction to CCFRA will help serve as a context for my comments.

CCFRA is the world's largest independent membership-based food research and technology organisation. We provide our members with an extensive range of skills, services, facilities and resources to meet their immediate needs and to realise longer term opportunities. Members represent all aspects of the agri-food chain from plant breeding to food service and retail. CCFRA provides:

- a member-driven R&D programme worth approximately £2 million p.a.
- confidential consultancy
- analytical and testing services
- process and product development
- scientific, technical, legislative and market information
- training and professional development
- factory and laboratory auditing
- expert witness
- best practice guidelines, publications and software
- forum for scientific discussion

Not surprisingly, many of these activities align with the creed of the British Society of Baking.

Why bother with R&D? Other than for some parts of the academic community, R&D is rarely an end in its own right. R&D is however, an important part of the innovation cycle. To achieve innovation, the R&D needs to be focussed on the correct issue and the results need to be applied. Historically, the UK has an exceptional record in R&D with a (positively) disproportionate allocation of scientific publications and even

Nobel prize winners. However, many of the more successful nations have been smarter and quicker at the application of R&D.

There is, however, a valuable role for research to push back the frontiers of science and this is largely the preserve of the academic community. These will lead to the development of future materials and processes and some will result in disruptive technologies (i.e. change the paradigm in which we operate). Other forms of R&D help to better understand, often well known, observations from our daily life, for example, why do our processes work better on some occasions than others? The development of new materials, products, processes and equipment is the lifeblood of our and many industries; without this we will stagnate. Finally, R&D can be undertaken to protect the health of the consumer and this is often the area of concern of government. So R&D represents a diverse range of activities from gene mapping and nanotechnology to process changes and product development. Within this the academic community, research organisations and industry all have valuable roles to play.

My presentation will focus on the activities in cereal and cereal processing at CCFRA, which aim to combine science and technology to provide knowledge, services and products for the international cereals, milling and baking industries.

Our cereals R&D encompasses the whole grain chain, looking at the issues affecting grains (genetics, agronomy, storage, authenticity), through the myriad of processes we can apply to the final product. I can only give a snapshot of some of our work and will concentrate on bakery applications under four themes:

- understanding the mechanisms applying in a situation - illustrated by the checking of biscuits on storage;
- ingredient functionality and their role in final product quality, illustrated with the use of enzymes in baked products;
- understanding the effects of processing through non-invasive measurement of product changes during proving and baking;
- development of objective measurement techniques for baked foods and texture measurement.

Checking of biscuits

For a long time, manufacturers have tried to understand and predict the appearance of small hair-like cracks in biscuits and crackers; which make them more susceptible to breakage during handling. Working with Loughborough University, we have used an advanced sensitive measurement technique (electronic speckle pattern interferometry) to measure the strains that develop in biscuits. We believe this is the first instance of this method being used in foods. This has been coupled with measurement of material properties of the biscuits (e.g. moisture diffusion coefficients, fracture properties), and advanced mathematical techniques to model checking and so predict situations which may prevent its occurrence.

Enzymes in baked products

The addition of a maltogenic a/p/za-amylase has been added to bread and cake systems and shown to retard the staling of bread. The action of the enzyme is to modify the starch present by a limited hydrolysis of the starch chains. This reduces the extent of recrystallisation of the starch, a property related to firming. In cakes however, there was only a small effect. In cakes, the gelling of starch in the sugar syrup during baking is at a higher temperature than for bread dough, which limits the ability of the enzyme to operate.

A new lipase, Lipopan F, was added to cake batter systems. This lipase is able to produce emulsifiers *in situ* from the native lipids in flour and so replace added emulsifier. Baking studies showed improvements in cake volume and softening of the crumb that gave benefits over 14 days storage at 20℃. Preincubation of the enzyme in the liquid eg g, did not significantly enhance the effect.

Other enzyme strains have included xylanases, proteases and transglutaminases.

Non-invasive measurement of dough during processing and baking

Significant changes in the structure of bread and cakes occur during proving and baking. These are difficult to study *in situ* due to the nature of the product and the process environments. We have pioneered the use of X-ray computed tomography (CT) to study the internal structures during processing. CT provides high quality images in which individual bubbles are clearly visible. Processes seen in dough and bread include the effects of proving and moulding, oven spring, the formation of the break between the top and side crusts and the formation of the crust. For cake-type products, the factors affecting the structure were studied in detail. This improves our understanding of the development of common structures and

faults in baked goods and helps to identify strategies for product and process improvement.

Objective measurement of product quality

Texture is an important sensory aspect of many baked goods that affect consumer acceptance and repeat sales. A number of techniques are available to instrumentally measure texture. Our studies have shown that the optimal method of measurement differs for different baked goods and the interpretation of the data is critical to correlating sensory and instrumental techniques.

C-Cell is an image analysis system, developed by Calibre Control International and CCFRA, to facilitate the measurement of the structure and appearance of bread and other baked goods. A digital camera is used to take images of product slices and these are analysed to provide information on the slice and the cellular structure. This provides an objective alternative to the visual assessment of products used for quality control and

more detailed quantitative measurements that enable the effects of ingredient or process changes to be evaluated.

An active R&D programme which develops an understanding of how the behaviour of raw materials and ingredient during processing affects product quality is the foundation for helping the industry solve problems and realise opportunities. This will only happen by identifying real issues and through effective knowledge transfer including working closely with clients, the development of equipment, software, best practice guidelines and training.