A Revolution in the Production of Bakery Fats

B.E. Brooker

The universal use of scraped surface technology (SST) to produce fats for the baking Industry has led to the widespread belief that the shortenings currently in use for bread cakes and biscuits have been optimised with respect to their functionality in commercial products.

Although the quality of SST-produced fats have stood the test of time, there has been no way of optimising fat functionality in the absence of any detailed understanding of how fats produce their observed beneficial effects in these baked products.

It has been known for many years that it is the solid or crystalline fat phase of commercial shortenings that is required in the formulation of many baked products to improve crumb structure and to create optimal volume and texture. A mechanism by which fat is able to achieve many of these effects in bread and biscuit dough's and cake batters has now been elucidated and has been found to depend upon the ability of crystalline fat to allow entrapped air to expand without rupturing during the baking process. In the absence of fat or too little fat, bubbles expand so far but then rupture as the gas inside them continues to expand. Fat crystals allow continuous expansion of bubbles during the early stages of baking by providing them with extra surface until starch gelation produces a stable matrix. This mechanism predicts that the smaller the crystals in the shortening, the greater will be the amount of surface material transferred to the bubbles, the larger the number of bubbles surviving baking and, consequently, the better the quality of the crumb structure and the larger the volume of the product. This principle explains why the small P' crystals produced by SST produce better results than the much larger crystals of the P polymorph. The same principle also predicts that a process that produces fat crystals that are much smaller than those that can ever be obtained by SST will therefore produce fats of rnuch greater functionality. This prediction was tested in the laboratory by producing the smallest possible fat crystals by a method that involved subjecting molten fats to extremely high cooling rates.

Experiments in which molten commercial shortenings were rapidly crystallised by spraying into a liquid nitrogen such as liquid nitrogen or liquid air, showed that fat crystals were produced that were significantly smaller than the corresponding control produced by SST. In laboratory-scale baking experiments the functionality of these ".microcrystalline fats" was significantly better than that of the control, SST-produced bakery shortenings, in terms of increased volume, finer and more uniform crumb texture and greater uniformity of product.

These results suggested that rapidly cooled fats could be used commercially to improve product quality or to produce baked products of conventional quality but at lower fat levels.

Laboratory baking experiments with a range of baked products, including bread, biscuits and cake, showed that the level of fat reduction that could be achieved in the final product without loss of quality varied from one product to another but this was typically in the range 10 - 30%. Importantly, the organoleptic properties of products with up to 25% reduction in fat could not be separated from controls by taste panels and informal tasting. Part of the explanation for this surprising result probably lies in the very different distributions of fat in the experimental versus control samples.

The importance of these findings is that they provide a route to produce lower fat, traditional baked products that are usually very sensitive to reductions in the total fat content, simply by changing the physical state of the fat, viz. reducing the fat crystal size of the shortening.

However, before such principles could be exploited commercially, it was important to be able to produce microcrystalline fats on a tonne/hour basis. After an extensive search, it was found that a piece of equipment that had been developed, produced and patented by BOC Gases (European Patent No. 0393 963) operated on the same principal to that used in the laboratory for the production of microcrystalline fats. In this machine, which was developed for quite a different purpose, rapid crystallisation of the fat is achieved by the intimate mixing, at high velocities, of a spray of molten fat or shortening with a similar spray of a liquid cryogen, typically liquid nitrogen.Extensive trials with commercial bakery fats that had been produced in bulk in a microcrystalline form with this plant showed the same improvements in

functionality as those seen previously in laboratory-scale baking trials in a very wide range of bread, cake and biscuit formulations,

This development provides a means of improving the functionality of commercial

bakery fats by substantially reducing fat crystal size and without the need to use the fat replacers. This should permit the more flexible use of fats to modulate quality and fat content in both traditional and newly developed baked products.