Surface and Sub-Surface Mapping of Whipped Toppings using Multiple Methods

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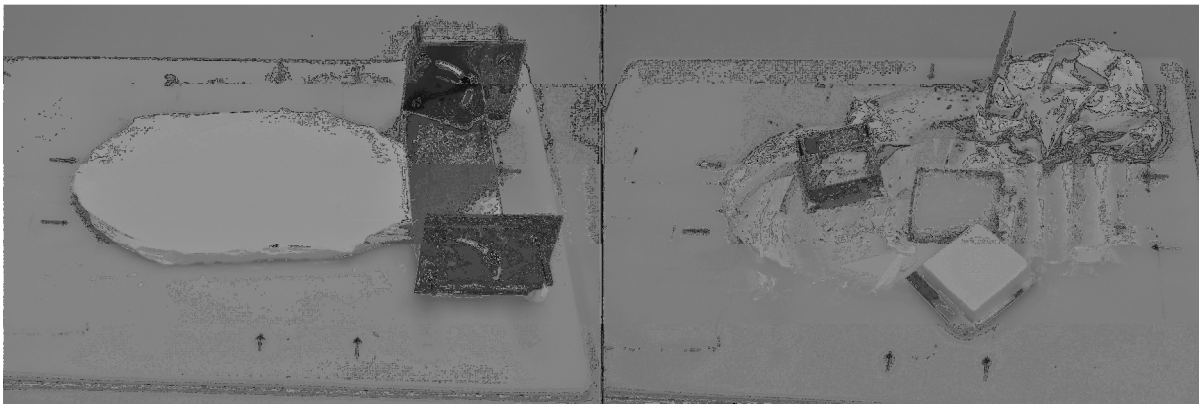
Whipped toppings are complex, highly variable and dynamic foam systems. They contain multiple phases, including; aqueous solutions of sugar, proteins and surfactants, oil, fat crystals, protein gels and air cells. These are all important to the final structure of the foam, the methods of manufacture and handling can alter these in number of ways depending on the process history.

The final appearance of a whipped topping, and how long it will look like that for, are key to the success of the product, and importantly, if the consumer will use the product again. The appearance and the overall structure of the topping are intrinsically linked. These two reasons; the ability to establish whether a customer will appreciate the topping's appearance or not, and also; to establish which processing techniques affect the appearance in what way, are drivers in finding out as much as possible about the appearance of the product.

The surface of a whipped topping can be affected both by the bulk characteristics of the topping and the way the topping is applied or spread onto the base material. However the spreading also has the potential to affect farther into the topping than just the very surface layers. Therefore understanding how the two parameters affect the way a whipped topping looks, both initially and over time is of great interest to bakers and cake decorators whose livelihoods depends on the way the final product looks as it sits on a shelf.



[*Figure I – Sampling method for whipped toppings*]

Currently visual checks are used to establish the characteristics of the whipped topping's surface. This method of testing though needs not only training, but experience, and the results can vary from person to person and from day to day, depending on the person's preferences, mood, and ambient conditions. It is therefore desirable to establish a method of determining the surface characteristics of a whipped topping that is impartial and consistent.

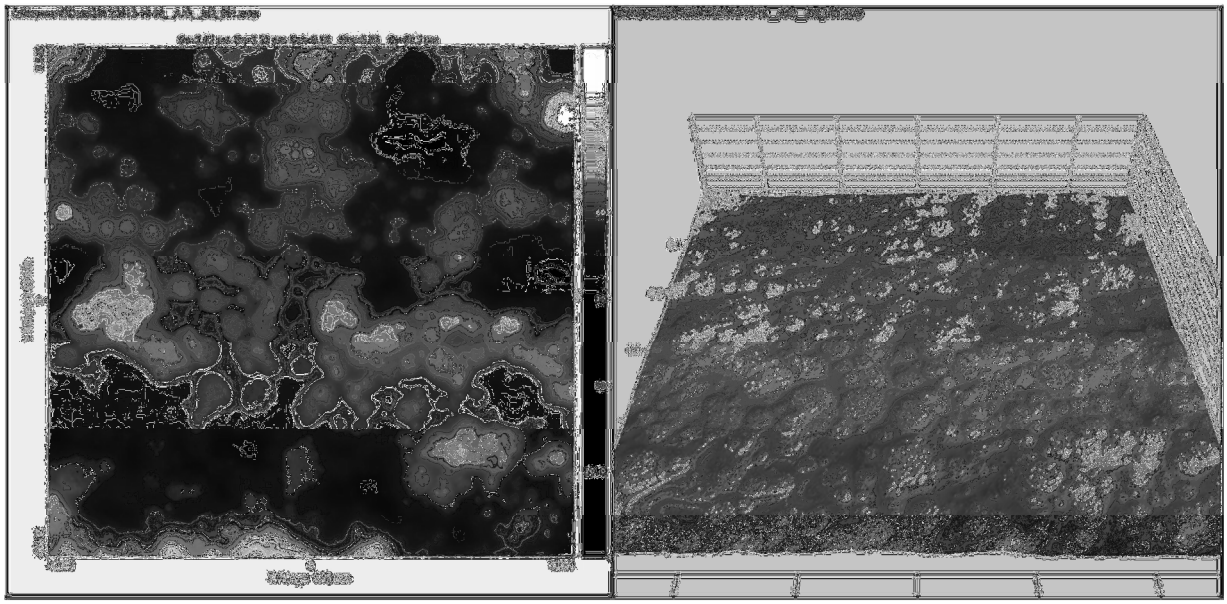
Several methods of testing can be used; Photography, Interferometry, X-ray Computed Tomography (X-ray CT) and cryo- Scanning Electron Microscopy (cryo-SEM). These methods have been used, cross

referenced and assessed to establish which is the easiest and most reliable for testing whipped toppings.

To ensure a standardised method of preparing and sampling the whipped toppings, as well as for space saving storage, a sampling method was established. This sampling method used a doctor blade to ensure an even, flat, spread and a cutter to ensure a standard sample size [*Figure I*].

Photography, although requiring no less training, allows for a second opinion to be established for an identical image. The use of photography led to the idea of using imaging software, to analyse the photographs, allowing a far more standardised testing of the whipped topping's surface. However the resolution and colour differentiation, even of an SLR camera, is too poor for adequate accuracy.

Being designed for the purpose of assessing small changes on a surface, Interferometry was then used as a more accurate, yet still relatively simple, method for assessing the whipped toppings. The topographs [*Figure II*] gave various values such as; surface roughness, peak range and surface area. These values where then compared to previous visual results to establish parallels between the two methods.



[*Figure II – Topograph (left) and 3D rendering (right) of a whipped topping*]

X-ray CT was also used to establish how far into the whipped topping the surface characteristics ran, and to establish if there was any correlation between depth and longevity. Cryo-SEM was used to visualise the surface with even greater accuracy, and determine what the artefacts that give the surface its roughness, etc, values actually are.

The combination of imaging methods gives a greater understanding of the surface of a whipped topping, and leads to the potential for standardised testing for this and similar materials in the future.

N.B. *Information presented in this abstract is confidential and must not be disseminated outside the department/university.*