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Building a product blueprint for successful innovation

The use of blueprints in food & beverage innovation

Professor Kathy Groves

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38

Building a product blueprint for successful innovation

The building of a new house, bridge, road or factory cannot progress without a blueprint or technical plan to ensure everyone knows the end-goal and how to get there. In this white paper, Professor Kathy Groves argues for the use of blueprints in food and beverage product innovation and their application in product reformulation and product consistency.

Food manufacturers and retailers are constantly innovating to set or respond to trends. Successful innovation can mean the difference between a company's growth and failure. Creating a product blueprint is the way to take the guess-work out of innovation, ensuring none of the innovation process is left to chance.

A blueprint of a product is essentially a map showing the ingredients in that product, the state of those ingredients, how they are distributed throughout the product and which ingredients are responsible for the product properties. Armed with this knowledge, the manufacturer can set baselines for innovation and carry out a number of important activities with confidence, including:

- Reformulating to respond to trends such as 'natural', 'clean label' and the demand for healthier foods
- Producing a consistently high quality product anywhere in the world by understanding the impact of production variations e.g. ingredient supply chain variations
- Responding to new developments in manufacturing processes, packaging or preservation methods
- Conforming to different regulatory requirements at a country by country level.

The iterative method vs. the scientific method

Setting out to create a new product, or modify an existing one, for example in response to the demand for healthier foods, the knowledge of the product developer and the ingredients supplier is typically combined to create the first prototype product. Invariably the product will need further development and this is done by adding or changing ingredients, or refining the process. The second, and any subsequent iterations, are usually evaluated by tasting. This iterative process is also a feature of development at the full manufacturing site, as there are inevitably points during the manufacture where the process needs 'tweaking' using the experience of key staff.

In both of these cases there is a better way to innovate, and this is to create a science-based blueprint of the product. By creating a

blueprint, the properties of the ingredients in the product are known, and when changes are made to the product, the effects can be anticipated. This process allows the product developer to not only get to the desired end product quicker, but also with a clear understanding of how they got there.

So the question is why don't manufacturers use the scientific method all the time? It is because creating a blueprint is not easy. It involves using several specialist techniques to develop the information for the blueprint – this is often outside the company's expertise and timeframe. However, the alternative, iterative method only appears easier. In fact, the iterative method takes longer since the end point is not defined, and in the long term is more costly to the company since the effects of the changes are not understood. When manufacturing is not understood, it can lead to catastrophic failure of the product, but also more importantly does not allow the company to respond to changes quickly.

Building the blueprint

A number of techniques are used to develop a blueprint for a product. Microscopy, rheology and sensory profiling are key. These should be combined with chemical information and shelf life studies to create the complete blueprint. This can then act as a baseline for your innovation, helping you make product changes with confidence.

To give you an idea of how Leatherhead builds a blueprint and what can be learned, take the example of a biscuit. The crumb of a biscuit is key to the texture; this can be clearly seen using simple light microscopy. More information on the nature of the ingredients and their distribution can be obtained by cutting thin slices through the biscuit and using polarised light or staining to show the location and state of the ingredients. Scanning electron microscopy can be used to show the three-dimensional crumb matrix in more detail and obtain information on the location of ingredients such as fat and salt. The microstructure reflects the result of the formulation and the manufacturing process, and as such is key to delivering the blueprint of the product.

Instrumental texture analysis provides quantitative information on properties such as the hardness, brittleness and elasticity of products. This technique is ideally combined with sensory profiling to give a descriptive map of the important sensory attributes that the microstructure is related to.

Further analysis of the ingredients and the dough formed during manufacture is vital in building the complete picture of the process used to make the biscuit.

Putting the blueprint to work

As an example of a reformulation exercise using the biscuit blueprint discussed above, several different formulations were prepared to show the effects of changing the ingredients.

In one example, the sugar was completely replaced by a bulk sweetener typically used in sugar-free products. Under the microscope the crumb was different in the sugar-free biscuit, having an uneven distribution of air and a change to the interaction between the starch, fat and sugar. Figure 1 shows a comparison between the standard biscuit and the sugar-free version. The sugar-free biscuit did not expand during the baking as much as the

standard biscuit and had dense areas of crumb, as well as large air pockets. Sections through the biscuits showed a difference in the interaction and distribution of the starch and protein (Figures 2a and b). Texture analysis of the two showed that the sugar-free biscuit was in fact softer.

Similar microstructural differences were seen in the doughs before baking, therefore the change from sugar to sweetener acted at an early stage.

So a simple exchange of sugar for sweetener altered the colour, structure and texture of the biscuit, as well as the distribution of fat, starch and protein. These changes can be mitigated to some extent; however to produce a sugar-free product which has the same texture and properties as the standard biscuit requires an understanding of why changes to the product's properties have occurred. Once these are known, then possible causes of these differences can be listed and methodically eliminated to understand the causes of the changes.

In the next few years, we expect companies that use the blueprint as a development and/or quality tool to have a significant advantage over those that do not. An increased understanding of product behaviour builds rapidly with the application of these methods and with that, a culture of seeking answers

Fig. 1a standard sugar biscuit

Fig. 1b biscuit made with bulk sweetener showing reduced expansion & uneven crumb

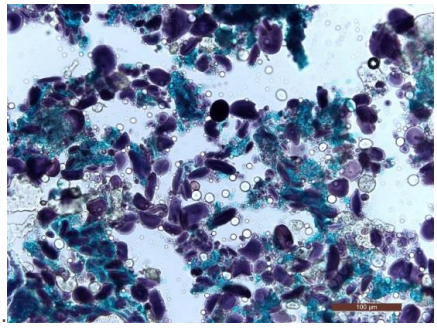

Fig. 2a showing the starch (purple) and protein (green) in the standard biscuit

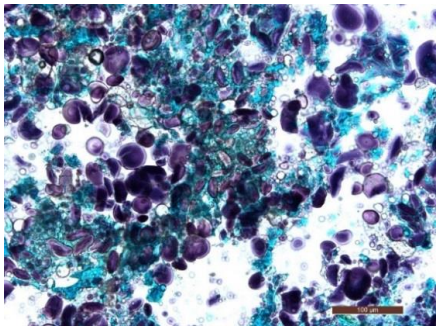

Fig. 2b showing the different starch and protein distribution in the softer sugar-free biscuit

follows; as does the ability to make very specific improvements to products and anticipate the consequence of formulation changes. The scientific method of creating product blueprints takes the guess-work out of innovation. While on the face of it, it may seem like a time-consuming exercise, in the long term it will save time and money. And the real value of using the blueprint method, is that the more it is used, the more useful it becomes. Manufacturing processes and ingredient functionality can be understood to a greater extent, freeing up the product developer to focus their time and energy on new product innovations.

How Leatherhead can help

Leatherhead can work with your innovation team to develop blueprints to help you carry out key innovation activities with confidence, including:

- Producing a consistently high quality product anywhere in the world
- Reformulating to meet trends such as ‘natural’ and ‘clean label’
- Responding to new developments in manufacturing and processing
- Conforming to global, regulatory requirements

About the author

Professor Kathy Groves is Head of Science & Microscopy. She has over 35 years’ experience in food microscopy and product development where she has pioneered the use of microscopy for food structure analysis and quality assessment. She has applied her expertise across multiple categories including snacks, confectionery and beverages, and numerous research areas including protein functionality, starch and fat interactions, meat quality and emulsions.

Kathy has a degree in Biochemistry, is a Fellow of the Royal Microscopical Society and a member of IFST. She is also Visiting Professor at the University of Chester and has presented on nanotechnology and food to the Government’s House of Lords Select Science Committee.

About Leatherhead Food Research

Leatherhead Food Research provides expertise and support to the global food and drink sector with practical solutions that cover all stages of a product's life cycle from consumer insight, ingredient innovation and sensory testing to food safety consultancy and global regulatory advice. Leatherhead operates a membership programme which represents a who's who of the global food and drinks industry. Supporting all members and clients, large or small, Leatherhead provides consultancy and advice, as well as training, market news, published reports and bespoke projects. Alongside the Member support and project work, our world-renowned experts deliver cutting-edge research in areas that drive long term commercial benefit for the food and drink industry.

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Originally founded by Professor Gordon Edge as Scientific Generics in 1986, Science Group was one of the founding companies to form the globally recognised Cambridge, UK high technology and engineering cluster. Today Science Group continues to have its headquarters in Cambridge, UK with additional offices in London, Epsom, Boston, Houston and Dubai.

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