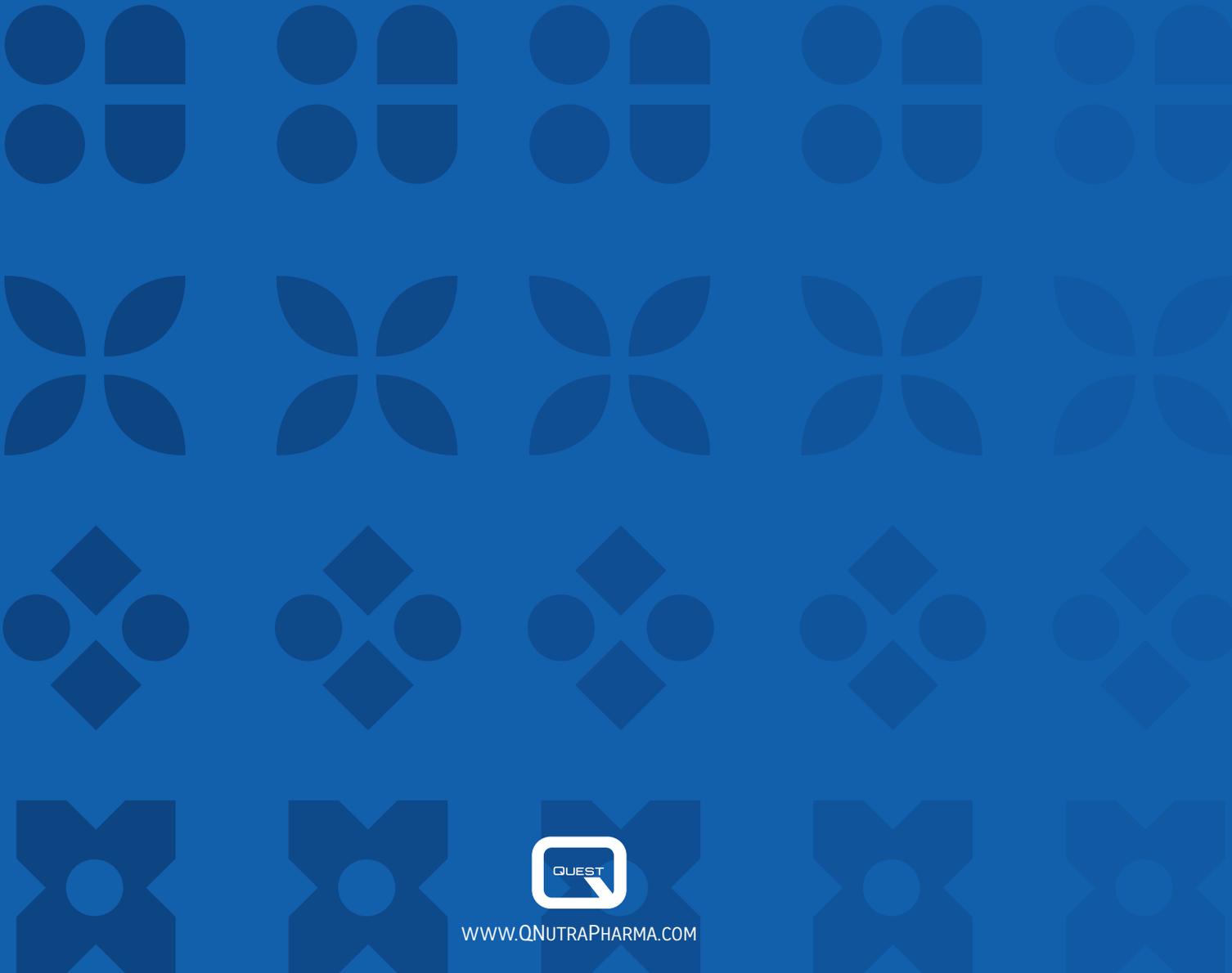


HOW CAN REVERSE ENGINEERING HELP

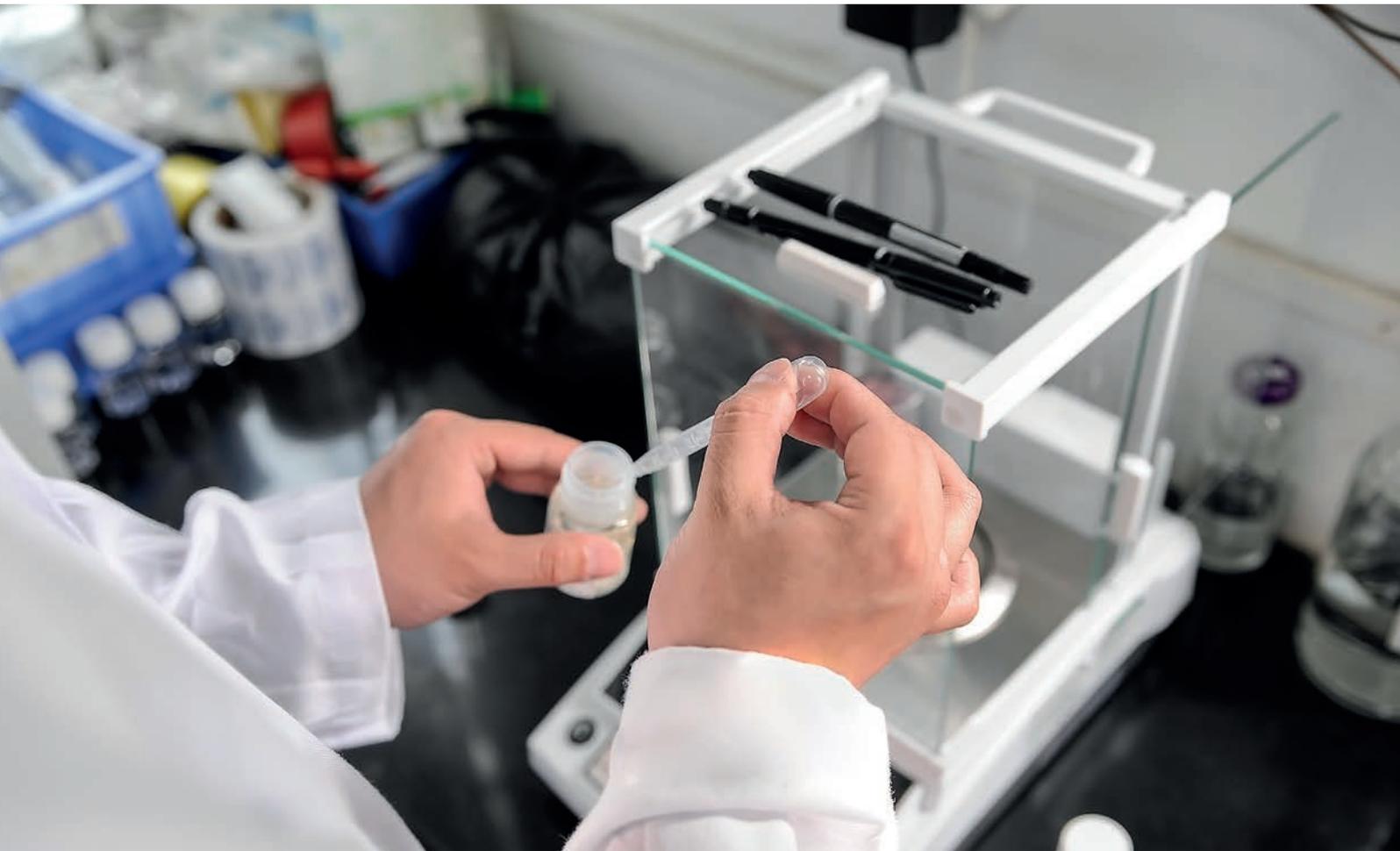
YOUR FOOD BUSINESS





Reverse Engineering has become a key process in the F&B industry, with a wide variety of applications.

In this paper, we explore the implications that reverse engineering has on areas as diverse as New Product Development, Ingredient Replacement, Competitor Benchmarking, Patent Infringement and Quality Control.



What is Reverse Engineering?

Reverse Engineering is a process that food technicians apply to food and beverage products in order to determine the composition of that product, identify how it was made and in many cases create a similar product.

To understand how flavour matching works, it is helpful to think of food production (or cooking) as a series of chemical reactions involving raw ingredients. By combining specific quantities of these ingredients and playing with variables such as temperature and time, a final product is produced.

The Intersection of Science and Art

The flavour matching process usually starts with a gas chromatography test that identifies the compounds present in the food item and the quantities in which they occur. However, whilst a chromatograph test is extremely helpful, it is still essential to have human input. The IFT (Institute of Food Technologists) note that a trained flavourist can identify aromas from particles that are 100 times smaller than those which register on a chromatograph test.

Identifying the ingredients present in a product, also known as deformation, is just the first step of the flavourist's journey. What is more difficult is understanding the journey that those ingredients went on. In other words, reconstructing the series of chemical reactions that led the final product to have its particular flavour, texture, colour and nutritional value.

Finally, the flavourist must chart out a path to replicate the final product with whichever restrictions or changes are required by the principal. This opens up a range of creative options, including the use of essences, powders and oils. For example, the flavourist might be mandated to replace a particular ingredient with a more cost effective substitute – this is the artistic part of flavour matching and brings us on to the opportunities that reverse engineering creates for food manufacturers and brand owners...

GAS CHROMATOGRAPHY – MASS SPECTROMETRY

This is the standard technique used for the initial stages of deformation in the food industry. It is actually the combination of two tests (as shown by its name). Gas Chromatography is the transport of the sample, in gas format, up a capillary column. Depending on chemical properties, molecules will separate off at different points. This in itself already gives the lab plenty of information regarding the substance.

Passing through the Mass Spectrometer then provides the lab with more detailed information, which, in combination with the data from the gas chromatography portion of the test, enables the specific identification of substances with a reduced false positive rate.

The Mass Spectrometer works by ionising the molecules which have eluted from (exited) the capillary column. This breaks up the molecules and the Spectrometer subsequently identifies the resulting fragments by their mass-to-charge ratio.

New Product Development

Innovation has become crucial for food brands. Consumers are exposed to different culinary cultures and are much more willing to try new flavours and textures than in the past.

The rise of social media and Instagram in particular has led to the widespread proliferation of experimental food combinations through social sharing. This means that to stand out, brands need to constantly push boundaries and offer novelties, aggressively incorporating flavours that may not be traditional to the markets in which they operate. A good example of this is the crisp industry, which regularly pushes out limited edition releases of flavours. There are up and coming brands such as Manomasa that base their entire brand identities on diverse flavours such as Beef Barbacoa and Dill Pickle or Serrano Chilli and Yucatan Honey, but even market leaders such as Walkers have an aggressive limited edition strategy, including producing seasonal flavours such as Brussel Sprouts or Turkey and Stuffing.

Ingredient Replacement

Creating such flavours asks the food technologist to consider how they can reverse engineer the flavour of these ingredients. This might be through using extracts or powders from the actual ingredient itself, however it is also possible to create formulas using acids, sugars, salts, esters and other additives that are unrelated to a raw ingredient, and yet create the same flavour profile by hitting relevant receptors on the consumer's tongue.





This technique is particularly useful when the raw ingredient is difficult to procure, very expensive or if the quality of ingredient available is not consistent.

Certain ingredients are also not stable enough for commercial food production and reverse engineering these ingredients can be vital. Products that have a citrus flavour can often be susceptible to this issue, and indeed, citrus and chocolate are two of the most popular flavours that are reverse engineered.

Citrus is of particular concern, because the raw ingredient quickly oxidises. Therefore, a technologist might choose to select an oil extracted from orange (or lemon peel) and use this to recreate a flavouring that can be added back into the product.

Nowadays, food technology processes can even go a step further by identifying the aspects of a flavour that most appeal to a consumer (that moreish feeling that you get from certain foods) and enhancing that element of the flavour.



IN FOCUS – MATCHING CHOCOLATE FLAVOURS

Chocolate adds flavour to sweets, but it is also used in savoury applications, such as mole sauce. It can be preferable to work with a chocolate flavour, such as one derived from natural chocolate extracts, rather than whole chocolate, because it can be more stable in the final processing environment. You can also fine-tune the subtle tones of a flavour and flavours are often less expensive and easier to source.

Selecting cocoa extracts and powders that give the same mouthfeel and taste as the target is the primary challenge in matching chocolate flavours, whether for a gooey and rich spread or a creamy and milky drink. A knowledgeable flavourist will select one or two cocoa extracts from the hundreds available to build the foundation of the chocolate flavour match. From there, the addition of a handful of other raw materials such as aroma molecules and essential oil – plus excellent analytical tools and a strong dose of creativity – will lead to a good match.

Benchmarking Against Competing Products

Understanding how your product compares to competitor products can help in a variety of different ways. In particular, benchmarking can work well in tandem with customer focus groups and surveys. If a competing product consistently outperforms yours in taste tests, then deformulation can help to understand what they are doing differently to you and help you assess whether it makes sense to run experiments with different formulations of your own product.

Benchmarking can also be a useful tool for marketing departments, helping them validate claims and be clear about what differentiates them from the competition so that this can be highlighted and advertised.

Patent Infringement Investigation

Deformulation can be vital to proving infringements on patented formulas. Accredited technologists and labs can identify what ingredients are present in competing products, and to what quantities, and then compare these findings to your patented formula. They can then produce a report to act as evidence supporting any infringement action.

Quality Control

For commercial manufacturers, consistency of product is key. This consistency helps brands meet their customers' expectations and earn their loyalty. Deformulation of faulty samples alongside a sample that represents the expected quality allows manufacturers to understand which part of the production process is causing inconsistencies.

Likewise, effective deformulation and testing can identify any contaminants and aid compliance with regulators as well as compliance with any internal specifications. This principle can also be applied to testing ingredients, making sure that suppliers meet quality guidelines.





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