Guide: To solving food product problems

Contents

Introduction

When food quality or safety is compromised, understanding what has gone wrong and why is vital. Let's take a closer look at some of the most common problems and the analytical techniques that can provide the answers you need.

The root cause of certain issues may be relatively easy to identify. A fruit cake that's missing its usual cherries is likely to be the result of an operator forgetting to add them to the hopper. Quality problems caused by an oven not reaching the required temperature can often be traced back to a failure in the processing alert system. But it's not usually that simple.

Unexpected problems related to raw materials are much harder to identify and explain. Even characterisation can be difficult, given that the same source of contamination can cause discolouration in one product but create an off-flavour in another. If you also consider that all the ingredients, packaging materials and chemicals used in or around the processing environment need to be taken into account, then the scale of the challenge becomes clear.

So what's the solution?

As you might expect, each problem demands a tailored response. Some may be explained through a relatively simple analytical test, while others will involve a multi-disciplinary approach. Either way, the goal of every investigation is to explain and resolve the issue as quickly and effectively as possible – and prevent it happening again.

Here we explain how different analytical techniques can be used to investigate some of the most common problems in food manufacturing.

Foreign bodies

Physical contaminants, also known as foreign bodies can broadly be classified as follows:

EXTRINSIC

Materials from external sources that have no place in food products. They may be introduced accidentally during processing, such as metal swarf and plastic fragments, or as an act of deliberate tampering.

INTRINSIC

Unintended materials typically found in the raw ingredients, such as bones and gristle in a meat product or a leaf and stalk in a pack of frozen vegetables.

It's also possible that an unexpected product failure could present to the consumer as a potential contamination issue. Crystallised ingredients, for example, may look like glass fragments, while a smear of raspberry jam on white icing could be perceived as blood.

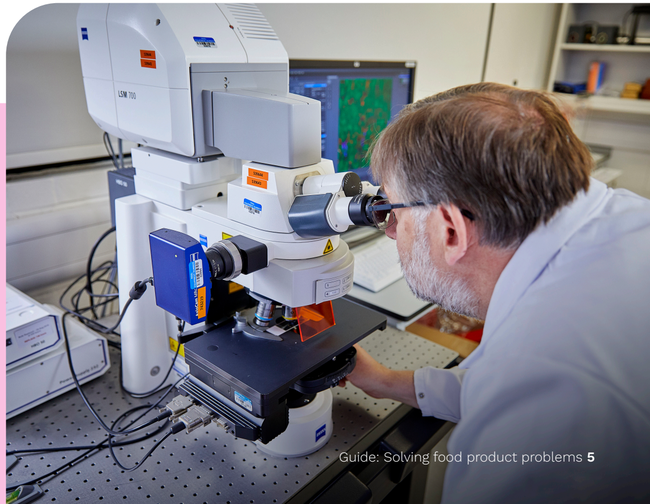
The process of identifying the precise nature of the foreign body often starts with light microscopy. This simple analytical technique is used to determine features that are typical or characteristic of likely candidates, with the results providing direction for further investigations using more sophisticated methods.

In our extensive experience, it may even be possible to find out whether the foreign body has been processed alongside the food, added afterwards or come into contact with other ingredients - valuable data that can help you identify where it came from and how it got into the product.

Case study examples include:

A suspected **fingernail in a ready meal:** Our broad capabilities in **microscopy** and **DNA testing** found the sample was a fragment of chicken bone that came from the product's meat content.

Abnormal black specks in multiple batches of a finished product: Using a range of techniques to characterise the **physical properties** and **microstructure** of the contamination, we determined it was caused by the breakdown of rubber seals in the food production line – and traced the exact location.



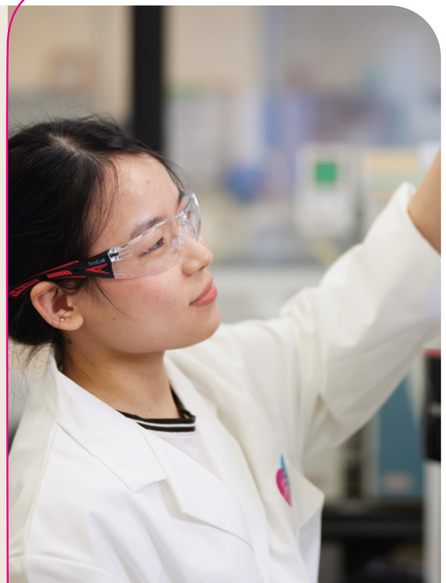
Taints & off flavours

An unpleasant or inappropriate taste or smell in a product is generally - although not always - due to the unexpected presence of chemicals. The product itself may be directly contaminated, but there are a variety of other possible external causes ranging from packaging and storage containers to microbial spoilage and cleaning fluids.

The ability of any chemical to taint a product largely depends on two factors; the strength of other flavours present and individual consumer sensitivity. A natural yogurt, for instance, might be more vulnerable to taints than a highly flavoured fruit yogurt. But, given that some potent taints have a flavour threshold (taste or odour) as low as 20 parts per trillion (ppt), you can't assume they will automatically be masked by other flavours or go unnoticed by most consumers.

In fact, there are thousands of potential tainting chemicals in widespread use, which makes isolating and identifying an individual culprit a major challenge. That said, certain groups or families of chemicals do give rise to specific flavours and/or odours that an experienced analyst can recognise. Cheesy and rancid flavours tend to be indicative of short chain fatty acids, soapy notes are associated with longer chain fatty acids and musty off-flavours often belong to particularly potent haloanisoles. But this list is far from exhaustive.

A taint or off-flavour can also originate at any point in the supply chain; from production of the raw materials all the way through to consumption. That means analysts must consider farms, ingredients, suppliers, transportation, storage, packaging, processing, retailing and even the home of the consumer making the complaint as the potential source.



So where do you start?

These investigations usually involve an initial human assessment, either by the analyst or trained sensory panel. The suspected chemical then needs to be extracted at detectable levels, free of other chemicals that might interfere with analysis and - in the case of volatile odours – before it is lost to the atmosphere.

This is a hugely complex process, but generally follows one of two possible routes depending on the anticipated chemical in question:

Organic (carbon-based): Chemically extracted, separated via chromatography (liquid or gas) and identified using **mass spectrometry** or nuclear magnetic resonance spectrometry.

Metallic: Detected using inductively coupled plasma (ICP) **mass spectrometry** or ICP-atomic emission spectroscopy.

Most importantly, this analysis needs to establish whether the tainted product is a risk to public health as quickly as possible. For example, consumer complaints about an unpleasant taste and odour in a **savoury sauce** raised a potentially serious contamination issue for our client.

As a member of our **Emergency Response Service (ERS)**, they benefited from a rapid analytical service involving informal sensory analysis, taint analysis including the mass spectrometry technique and a **toxicology risk assessment**.

This gave them the information they needed to avoid a product recall as the taint was identified and levels confirmed and the team then worked with the client to safeguard consumer safety.

Product performance

Product or process can fail for any number of reasons, many of which can be investigated using physical chemistry methods. **For example:**

Resistance to flow

If a material doesn't flow smoothly against different surfaces or internally, it can disrupt manufacturing processes and damage the quality of the final product. By using **rheological instrumentation** to measure the sheering forces that determine the flow of materials used in formulations, we can determine the source of the problem.

An unstable emulsion, visible separation or gritty feel

These problems are usually related to particle size or shape. **Laser diffraction**, often in combination with **microscopy** techniques, is one method of choice, while static image analysis offers a useful alternative to manual microscopic measurements.

Poor ingredient distribution

Whether this means 'bottom heavy' chocolate chip muffins or bread rolls with a dense structure, specific analytical techniques – from simple light microscopy to **computerised x-ray tomography** - can be used to explain why a product is performing badly.

Of course, this is just a snapshot of the range of issues that can cause product quality or operational performance to drop. But in every case, our experienced food analysts have the tools to help you successfully resolve the issue.

Allergens & illness

A consumer complaint about a possible allergic reaction or physical illness following product consumption is a major cause for concern. While microbiological testing can address pathogen contamination, investigating allergens is often a more complicated process.

Two methods are routinely used to test for protein based allergens:

- ELISA (enzyme-linked immunosorbent assay) techniques are directed at specific allergenic proteins
- DNA techniques detect trace amounts of DNA associated with allergenic ingredients

In both cases, you also need to be aware of the potential for interference that can lead to false positive and false negative results. This is particularly important when using ELISA techniques, so checking the product ingredients list to identify anything that could compromise the results is vital.

It's also essential to identify the potential allergens of interest. You need to know, for instance, if you are dealing with dairy proteins or nuts and then drill down to identify the specific type. This may involve using multiple methods to screen for different allergens or it may be possible to use just one method to confirm the source of the contamination. Given the potential for interference, we also carry out a **spike recovery test** to validate and build greater confidence in the results.

Authenticity & purity

There are many reasons for a product's authenticity to be called into question. A specific incident, notification of an industry-wide concern or a new supplier can all trigger the need to evaluate potential safety risks and quality.

DNA sequencing is one of the most effective and routine methods in this space. Not only capable of detecting the DNA of individual meat and fish species at very low thresholds – a vital consideration in the wake of the horse meat scandal - it is equally suitable for application with certain strains of rice and other ingredients such as nuts.

However, other authenticity issues are more complex. Olive oil, for instance, has well defined acceptable ranges for a variety of naturally occurring compounds, providing a set of parameters that analysts can use to assess its authenticity.

There are also recognised bio-markers for several other ingredients but not all have a defined acceptable range. In cases like these, further investigation into the many possible variables is the only way to reach a firm conclusion about a product's authenticity.

When adulteration is suspected, on the other hand, new analytical methods may need to be developed as a matter of urgency to address the specific problem. Increasingly sophisticated food crime, such as the melamine in milk scandal, may be able to circumvent standard tests, so having some idea of what the adulterant might be will help to speed up this process.

Do you need a problem-solving partner?

Find out how we use our proven analytical expertise and industry experience to investigate, explore and advise you on the best course of action.

Contact our Customer Services Team on **+44 (0)118 918 4076**

Reading Scientific Services Ltd
The Reading Science Centre,
Whiteknights Campus,
Pepper Lane,
Reading,
Berkshire RG6 6LA

Tel: **+44 (0)118 918 4076**
Email: **foodsales@rssl.com**
Web: **www.rssl.com**