

MAIN FEATURE: Food Fraud

# Food Fraud: Where are we?

## ABOUT THE AUTHOR



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studied food chemistry at the Technical University of Berlin and is the general manager of the GfL Berlin. GfL is a private counselling and service company which is autonomously and independently active for the entire food industry. GfL is one of the world wide leading laboratories in the field of fruit and vegetable juice and works for food producers, distributors as well as processing and bottling industry all from all parts of the world.

Food fraud is everywhere. If high-quality produce can be adulterated, mislabelled or in some way altered for commercial gain, there are individuals willing to do it. So, how can we combat this inevitability and ensure what lands in our shops and on our plates is what we believe it to be. Industry expert and commentator Mikko Hofsommer provides his insight...

### Overview

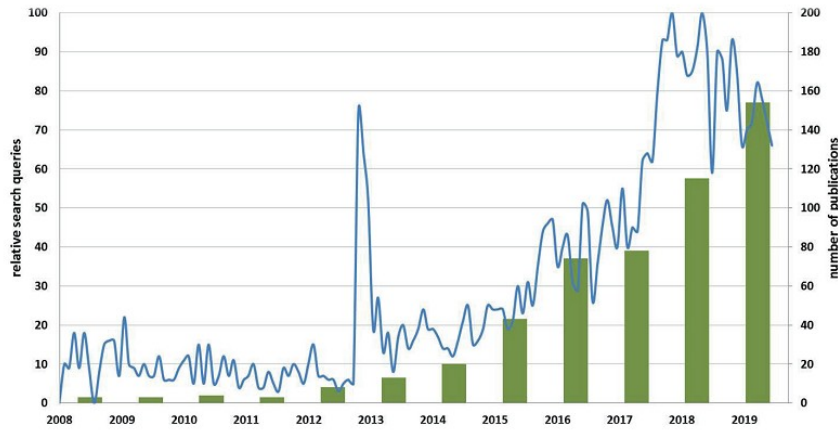
It has been said many times, but cannot be stressed enough – food fraud has always been with us and, maybe a little disappointing, always will be. So where are we? If you look through conference programs, workshop titles and into publications, one cannot ignore it – food fraud is everywhere

Figure 1 demonstrates the dynamics of food fraud. A graph that needs little explanation but impressively demonstrates how the 'horsegate' peak in 2013 has impacted the research world.

Both governments and industry have taken clear steps to keep the topic on the agenda. Europol has its OPERATION OPSON (1), several countries have specific food crime units including the U.K., Ireland, the

Netherlands and Denmark, and Germany has established the National Reference Centre for Authentic Food (NRZ Authent). The European Council has adopted further steps to improve ways of tackling and deterring fraudulent practices in the agro-food chain. Its press release from 16 December, 2019 quotes,

*"The Council nonetheless emphasises the need for continuous and improved cross-sectorial cooperation to fight against food fraud. This cooperation should include not only food and feed control authorities, but also authorities involved in the fight against financial crime and tax, customs, police, prosecution and other law enforcement authorities. In relation to this, the Council calls upon the Commission and member*



**Figure 1:** The worldwide relative search queries at Google.com (blue line) and number of scientific publications (review article, research article, book chapter) at ScienceDirect (green bars) for the specific term "food fraud" (adapted from Google.com and ScienceDirect.com, 2019)"



*The top ten lists only show what has been detected and was made public. But don't let these lists fool you – food fraud is everywhere.*

states to allocate adequate resources to ensure effective implementation of existing EU legislation by improving the shared understanding of the criteria determining food fraud."

Industry standards such as IFS have made clear commitments as well, in an attempt to avoid a second horsegate (2). The current IFS Standard (6.1 from November 2017) quotes, "The purchased products shall be checked in accordance with the existing specifications and their authenticity, based on hazard analysis and assessment of associated risks. The schedule of these checks shall, as a minimum, take into account the following criteria; product requirements, supplier status (according to its assessment) and impact of the purchased products on the finished product. The origin shall be additionally checked, if mentioned in the specification."

These developments are somewhat remarkable considering that not all food safety aspects have been addressed correctly as, for example, several huge Listeria cases in recent months have regrettably demonstrated. Of course food fraud can have safety implications as well, for example with regards to allergens. An important topic which will be covered by Dr Bert Pöpping in a later issue of *Food Analysis*.

Let's take a look at where, when and why food fraud occurs. An excellent analysis on

the circumstances that lead to fraud has been given by Andy Morling former Head of the Food Crime Unit U.K. (Figure 2). From criminalistics sciences the following factors have been found to make food fraud more likely:

- premium characteristics
- small to medium enterprises
- supplies major retailer
- finished product at import
- low consumer discernment
- demand spike
- supply pressure and high value add.

As one can see these are attributes which are present in every industry of course and also in every food category. There are criminals in every country and every business – it is part of the human 'DNA'. Why do I stress that? Everywhere you can read about the 'top ten' falsified foods. However, it is important to note that people commit fraud, not products or industries. So tell me, why should people in the olive oil business be more evil than in the vinegar business? The top ten lists only show what has been detected and made public. But don't let these lists fool you – food fraud is everywhere.

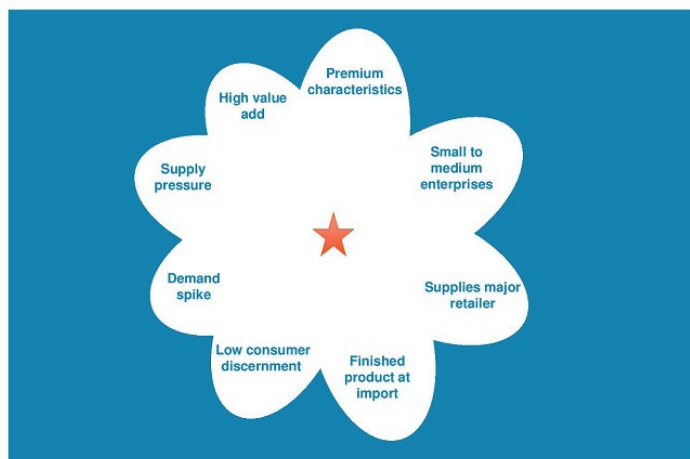
#### Detection Methods

This brings us to the question of how can we detect food fraud analytically. An excellent book recommendation is "Advances in Food, Authenticity Testing; Improving Quality



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**Figure 2:** BVL / European Commission, JRC; Food Fraud Congress, 12.-13. June 2017; Andy Morling, Head of National Food Crime Unit London

Throughout the Food Chain” edited by Gerard Downey, and published by Woodhead Publishing in 2016 (3). Of course investigative observation, whistle blowing, paper trails, mass balances and so on are further vital means to be discussed elsewhere.

The hot topic of the moment is “unknown” screenings and the logic is clear. One would like to detect every possible adulteration even if it is not known (yet). Is that feasible? Yes and no. Methods to screen for unknowns have always existed but were never called that. A simple thin layer chromatography method for artificial colour is nothing else. The differences/limitations are always only the limit of detection and the specificity of the detection. In the case of the human eye to see colour spots on the plate, analytical instruments are of course far more sensitive and unrestrained.

One of the currently very popular techniques is nuclear magnetic resonance ( $^1\text{H}$ -NMR). Why is that? Principally NMR represents a holistic approach. First, it does not need a lot of sample preparation which can always discriminate analytes. Second, it detects ‘every’ organic molecule (every molecule containing protons to be exact).

This amazing possibility however is at the same time also a drawback. A sample will produce an endless number of signals. These can only be evaluated by sophisticated statistical tools and accordingly trained

personal. Furthermore, such an approach relies on the comparison with authentic samples in a database, which has to consider differences resulting from origins, cultivars, processing technology and, of course, climate. Especially the later results in the need to maintain such databases. In case of deviations it is not automatically clear what causes these deviations and consequently there are difficulties making hard claims that will stand up in court. It is, therefore, a big task to define ways such methods can be validated. This is currently happening.

A second large field is “DNA Techniques to Verify Food Authenticity”, – a book of the same title was recently published by the Royal Society of Chemistry, edited by Malcolm Burns, Lucy Foster and Michael Walker which is recommended to the interested reader (4). As you’ll read in this book, stunning developments are taking place in this field. From a targeted approach to detect only single species such as horse to the ongoing trend towards so called ‘Next Generation Sequencing’. This will allow the ‘complete’ composition, even of a complex mixture such as curry, to be determined as long as the DNA is sufficiently intact.

Last but not least we need to address stable isotope analysis as one of best established techniques in food fraud. Also here a book can be recommended: “Food Forensics; Stable Isotopes as a Guide to

Authenticity and Origin" edited by James F. Carter, Leley A. Chesson published by CRC Press in 2017 (5). Stable isotope testing is somewhat unique because it enables us to differentiate origins of "identical" molecules. A simple example would be sucrose from beet or cane. In contrast to other methods the underlying science is well understood which makes it more suitable as a true legal proof. But also here we must admit that the methodology is far from perfect. Instruments are costly, need trained personnel and are far from being hand-held devices.

### Examples

Let's have a look at some examples of fraud in the juice industry. One of the biggest issues has always been the addition of sugar. And why is that? It's not because juices are regularly too sour, it is because juice concentrates are paid/traded on the basis of the 'Brix' values. To measure the concentration factor of a juice concentrate which logically determines its worth the refractive index is measured. This means the degree to which light is bent when passing through a medium. This value is expressed on a standard scale based on a sucrose solution in per cent.

In a juice concentrate this Brix value is first and foremost dependent on the sugar content, and hence the reason why a 'foreign' sugar addition is a 'reasonable' adulteration. So the terms of payment are the root cause of the falsification.

As a second example, lemon juice concentrate is used in many different applications as a natural acidifier. To lower the pH of a certain product you will need a certain amount of lemon juice concentrate. It is not difficult to guess that lemon juice concentrate is consequently paid by the concentration of acid (in g/L) and guess what type of adulteration could possibly occur? Yes of course the addition of biotechnologically derived citric acid.

Realising these interrelations between terms of payment and adulteration is an essential lesson. Such links of course also exist when ingredients or quality properties are laid down in specifications. Such an example would be blood orange juice.

Blood orange juice is unique and especially appreciated for its rich colour. However, the colour is only formed under specific climatic conditions – so called "cold stress". This means in certain years the crop may be poor in colour. When at the same time a certain colour is specified, the addition of other colouring concentrates such as black carrot have to be expected. In contrast, when the crop has a very intensive colour the juice 'will allow' the dilution with regular (blond) orange juice which is significantly cheaper.

Finally, in this context we should take a look at the melamine scandal of 2008. Remember, melamine was added to milk powder to mock a higher protein content. This is only possible because protein is specified by the so called Kjeldahl method which in fact does not measure protein, but nitrogen. Again the analysis method is/was key for the type of adulteration. As the consequences of a proper root cause analysis is very obvious that one only would need to change the analysis method in the specification. Such adulterations would stop overnight simply because "they don't work anymore". But instead labs all over the world are testing samples for melamine. Needless to say successful fraudsters are clever. There are an endless number of nitrogen-containing molecules ready to serve as alternatives and my guess would be that some are already in use.

### Where are we?

The scientific papers (Figure 1) will have to find their way into governmental and commercial routine testing. For this to happen significant investments will have to be made.

To get a better picture. The annual report (2018) of "the EU Food Fraud Network and the System for Administrative Assistants" by the European Commission (EU-AAC-System) lists 234 requests related to suspected food fraud. This is per year! For Europe as a whole!

My conclusion is that we are at the beginnings of a battle that can never be fully won. Already one can buy sugar syrups on Alibaba which specify the test they will pass when adulterating honey. In the midterm we will see more cases of food fraud rather than



less because we are looking for them. But let's face it, all efforts will not eradicate these practices. One can only try to remove oneself from the line of fire through proactive practices with appropriate analytical strategies.

For this, different disciplines, such as criminalist, journalist and analytic scientist have to join forces. Finally, buyers/procurement divisions must invest more into food fraud assessment teams and resources. Keep in mind if a price is too good to be true – it probably is.

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