HARNESSING SCIENCE

To Counter Fraud In The Food & Beverage Industry

The economic impact of counterfeiting products in the food and beverage industry amounts to millions in lost sales and profits to retailers, producers and suppliers. Fake claims about the content of foods and beverages also pose an unsuspected risk to consumer health, as well as to people who base their food choices on their ethical and religious convictions.

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Consumers make their purchases in good faith, putting their confidence in the honesty and integrity of the supply chain. Counterfeiting is at odds with this reasonable assumption that a product is all that it claims to be on its labelling. In contrast to the financial losses facing businesses on the production and supply side, the consequences to consumers can range from simply being deceived about the product's content, or not benefitting from the anticipated efficacy of the product, to the more severe outcomes of illness and death.

The world was made aware of this danger in 2008, when six babies died and 300,000 babies fell ill after drinking melamine-tainted milk products in China. Another major food scandal broke in Europe in 2013, when it was revealed that horse meat was being labelled as beef from cattle. Although horse meat is suitable for human consumption, the public health issue relates to the type of tests conducted to prove the suitability of the beef for human consumption.

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Despite the best efforts of national food safety authorities such as the Food & Drug Administration in the USA and the European Food Safety Authority in Europe, certain food and beverage product types continue to fall prey to counterfeiting. Notable examples include olive oil, basmati rice, honey, vanilla and saffron.

Olive oil is product that is produced to different standards by varying methods of production and its quality is also determined by the free acidity of the soil. The production and sell-by dates are also important, because olive oil eventually oxidises and becomes rancid. Since each of these factors determine the value of the end product, falsifying any of this information amounts to counterfeiting . In a similar vein, a variety of aromatic Basmati rice types are sold at premium prices on the world market and the increasing value consumers are placing on this product also makes it a prime target for counterfeiters who adulterate the product with the addition of cheaper types of long grain rice.

Honey can be counterfeited in various different ways. It can be adulterated with sugar, corn syrup and other sweeteners, or the type of honey is misrepresented by a fake declaration of botanical or geographical origin to attract a higher price on the market. Expensive spices like saffron and vanilla are frequently faked by being synthetically produced or are by being substituted with cheaper spices that taste and look the same thanks to food flavouring and dyes. Saffron is the world's most expensive spice, originating from a relatively rare crocus flower that tends to produce only about four blossoms in its lifetime. It is often counterfeited with other harmless plants, such as calendula or even dried onion dyed orange in colour. Saffron and vanilla are grown in many countries where a cash crop is sorely needed and

one of the consequences of counterfeiting is to rob such communities of a percentage of their livelihood.

Over and above the issues of public health, fraud and tax evasion, counterfeiting of food impacts the spheres of ethics and religion. Many consumers choose to avoid foods that contain beef, pork or other ingredients derived from animals, and falsely labelled foodstuffs deceive them into transgressing these principles.

The increasing penetration of counterfeit food and beverage into the consumer supply chain is prompting authorities to accelerate existing measures to intercept and identify these products. For example, during 2013, Customs and Excise laboratories in France ran half a million analytical tests last year on wines and beers entering the country, bringing the role of scientific analysis into sharp focus. Counterfeit goods are invariably undetectable by sight and smell alone and therefore samples of suspect goods must be analysed using sophisticated chemical analysis techniques.

The food standards authorities associated with counterfeit goods typically make use of expert food laboratories which run sophisticated instrumentation. Gas chromatography-mass spectrometry (GC- MS) and liquid chromatography-mass spectrometry (LC-MS) are routine in food and environmental laboratories, alongside High Performance Liquid Chromatography and Ultra-High Performance Liquid Chromatography (HPLC and UHPLC).

When more sophisticated analysis is required, Nuclear Magnetic Resonance (NMR) comes into play, the most advanced technique available for food counterfeiting investigations. NMR involves generating a very high magnetic field around the nuclei in a particular molecule to allow the nuclei to absorb and re-emit electromagnetic radiation. The pattern in which this occurs is detected to identify which particular molecules are

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present. The intense magnetic field is generated by a super-conducting magnet that can only operate in extremely cold temperatures. This is achieved by immersing the electro-magnet in liquid helium – the coldest substance on the earth.

The authenticity of olive oil can be established to a certainty of about 80% by analysing the most frequently occurring chemical components through Principal Component Analysis (PCA) and developing a "fingerprint" for a particular product. PCA typically identifies the top fifty naturally occurring chemicals and their concentrations, providing analysts with a good indication of the oil's geographical origin and how it was processed. Linear Discriminate Analysis (LDA) on some of the most occurring components compares these chemicals to the genuine article to determine how closely the sample resembles it. The instrument most likely to be used to conduct this sophisticated fingerprinting and profiling of the olive oil is NMR, harnessed to focus on isotopes of hydrogen to identify variations in the fingerprint.

Food analysis is a growing market and the demand for the specialty gases that facilitate the detection of ever lower levels of chemicals in food is on the increase. Linde has an extremely broad offer to the food industry through its HiQ® range that includes nitrogen and helium for GC-MS, nitrogen for LC-MS, liquid helium for NMR and helium gas for HPLC and UHPLC.

Through the use of industrial gases and advanced technology, it will become ever more difficult for counterfeit food to come to market, ensuring consumers canbe guaranteed safe, sustainable and ethical products.●