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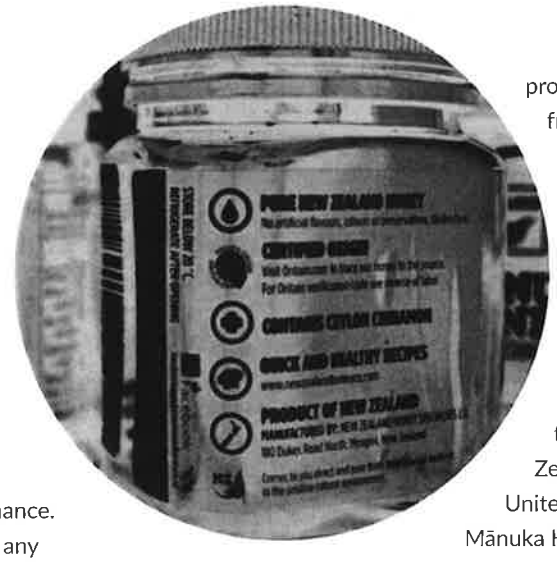
Adopting science to strengthen the integrity of supply chains

Since the domestication of agriculture supply chains have been in a state of flux – continually evolving in response to the development of technologies and changes in the marketplace. As price pressures continue to force increases in buy-sell nodes throughout the agribusiness sector, these changes manifest in an evermore complex structure of supply chains.



Food fraud

Likewise, and somewhat ironically, the globalisation of supply chains has coincided with an increasing consumer interest in the provenance of the foods they eat. Now food fraud has entered into the void created by price pressures, supply chain complexity and the greater value obtained for products with the desired provenance. Food fraud is a catch-all term for any misrepresentation of goods in the marketplace, whether through mislabelling, dilution, substitution or any other form of adulteration. It is estimated to cost the global food industry $US49 billion a year, not including intangible losses to brand damage.

New Zealand companies have not been immune to this global problem. The most costly and high-profile case was the 2008 Chinese milk scandal, where Fonterra alone lost $140 million as a result of its 43% owned Sanlu brand who were heavily involved in the incident. The reputational damage, both to Fonterra and to Brand NZ, is unquantifiable. As China continues to focus on heightened food security – in its own supply chain and in products imported globally – an ever-increasing light of scrutiny is being shone on premium products from New Zealand.

NZ mānuka honey in the spotlight

As with any product commanding a premium price over 'normal goods', mānuka honey has become a lucrative industry targeted by fraudsters. This honey is produced only in New Zealand from the nectar of the mānuka tree, and due to its origin and perceived health benefits it commands a premium price over most other honeys. As a result, and as is common in similar premium products, there is large scope for fraudulent practices within the industry. These practices are proliferating, with potentially damaging impacts on this lucrative export product.

According to international reports, there is more than 10 times as much mānuka honey bought by consumers than being produced by New Zealand. Recent articles in the United Kingdom detailing 'The Great Mānuka Honey Swindle' have not done our reputation any good. Much of the most recent supply chain fraud has related to the dilution of production lots of mānuka honey. With inferior honey of non-New Zealand origin now entering mainland China, and with a number of the major exporters looking to grow this market, this fraud issue will only increase.

At the same time, authentic mānuka exporters have a responsibility to protect the reputation of our industry. The Ministry for Primary Industries recently seized and recalled product from an Auckland-based producer who was found to be adulterating their product with a synthetic chemical used to boost the 'activity' of the honey for economic gain.

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Brand NZ

Benjamin Franklin famously said that it takes many good deeds to build a good reputation, and only one bad one to lose it. Commercial brands are ruled by a similar edict – their welfare flourishes until, with one lie or mistake, it fails. A brand is a promise to the consumer that the product they purchase is authentic every time they buy it. If New Zealand brands are to deliver on their promises, fraudulent practice must be stopped at every point in the premium product supply chain.

New Zealand exports as a whole trade off the untainted image and good favour that the country inspires in companies and individual consumers. This confidence and trust equals value creation for producers as they try to obtain premium pricing. However it also makes them vulnerable to the extraordinary risks of scandals and fraudulent practices of New Zealand exporters as a whole, and therefore to reputational damage and incalculable financial losses.

As a result it is imperative that a high priority is placed on maintaining and improving the integrity of Brand NZ and the reputation of our premium producers because, as shown in the mānuka honey industry, no-one is immune to food fraud. As consumers and retailers around the world become increasingly concerned about food safety, the demand for proof of authenticity is therefore also rising.

Traceability

The concept of both traditional and new adapted methods of traceability is to document the transfer of production lots as they move through a supply chain. For primary products, such as apples, this is a relatively simple process as they are traced from the orchard, to the pack-house, to freight, to the wholesaler and then to retail. Tracing is monitored only at steps where lots are, for instance, either consolidated (several orchards into a pack-house) or broken down (wholesaler to retail).

Traceability of ingredients for manufactured goods requires significantly more bookwork, especially as production runs of a final product can incorporate dozens of different primary goods. These processes rely on a form of packaging to hold a unique identifier of the product, which can be as simple as a lot number or as complex as a QR code. They have the ability to accurately document every movement of those product lots and to form a point-to-point overview of an entire supply chain. Often these aspects are not sufficiently traced, especially in the latter stages of the supply chain, as goods will pass through several owners who hold no responsibility for the products once they have been shipped from their facilities.

The limitations of traceability became apparent during the European horse meat scandal (or 'Horsegate') of 2013. There is a global trade (trade being the buying and selling goods as they are financial products) of beef trim used in the production of mince and ground beef products. The trading players in this market essentially have no direct use for the product and very little responsibility for it as it moves through the supply chain. In this case, horse meat cuts were traded between various entities and at some point the product was relabelled as beef trim. The mislabelled product was purchased by a processor/manufacturer and it entered into markets for human consumption. There was a reliance on the veracity of invoicing documents by each step in the chain without anyone having an overall picture of the actual provenance of the product.

Chemical fingerprinting

In forensic science the term 'fingerprinting' is used to explain the concept of generating a unique identifier, with three major principles to adhere to:

1) A fingerprint has an individual characteristic.
2) A fingerprint will remain unchanged over time.
3) Fingerprints have unique characteristics which allow them to be classified.

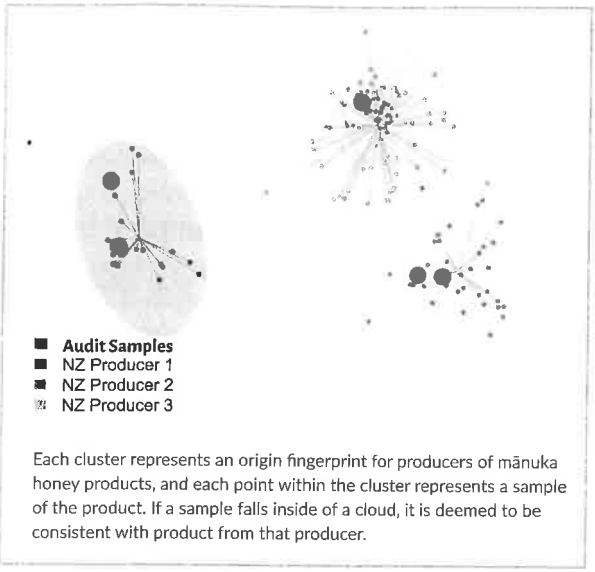
These principles can thus be adapted in many fields, with the major differences encountered with the third principle, i.e. the aspect you are looking to classify.

Chemical fingerprinting uses the same principles as applied above, except chemical parameters are the attributes measured instead of ridge lines on the skin of our fingertips.

The team at Oritain uses a similar approach, but the attributes needing to be classified relate to origin and provenance.

Within the limitations of traditional traceability described above, this is a method that can be used for proactively ensuring integrity throughout the supply chain and in-market. This type of fingerprinting measures what is in the product rather than what is written on the packaging.

The concept of chemical fingerprinting for provenance is simple, even if it is complex in practice. It relies on exploiting the measurements of a number of chemical specifications that are known to vary depending on the environment, geography and various production processes. Effectively, the values of these specifications depend on the product's origin.



Each cluster represents an origin fingerprint for producers of mānuka honey products, and each point within the cluster represents a sample of the product. If a sample falls inside of a cloud, it is deemed to be consistent with product from that producer.

By measuring a whole host of these specific chemical parameters, it is possible to develop a chemical fingerprint for a product from a particular origin. Suspect products can then be tested against this fingerprint to determine if it is genuinely from that origin. These parameters include the concentrations of multiple trace elements and stable isotope ratio, such as hydrogen, carbon, nitrogen and oxygen, which are passed from the soil and the atmosphere into plants and animals. The use of these for origin determination evolved from the forensic science field, where the techniques are used for numerous provenancing purposes. These have included identifying the origin of illicit goods, such as drugs, or determining the country, for instance, from which a murdered migrant originated to help to solve the crime.

Once a reference database of authentic samples has been created of the desired product and origin, a queried product can then be compared to this database to determine if it is an authentic product from that specific origin. However chemical fingerprinting is not a simple case of comparing numbers. It requires complex algorithmic and statistical modelling to combine these measured parameters, along with other considerations such as climatic and geological variables, to offer the most accurate and scientifically robust solution.

Chemical fingerprinting methods do not replace traditional traceability systems which track the movement of products – they are used alongside them to confirm the authenticity of products in the supply chain. Simply put, they audit the origin claim of products in the supply chain. A product can be taken at any point in the supply chain or in-market and compared, using chemical fingerprinting, to the reference database. This enables brands to check the integrity of their supply chain, lessening the risk of counterfeit and fraud, which in turn reduces the chance of brand damage and forced product recalls.

Reducing risk and adding value

All businesses and brands in the food supply chain are susceptible to fraud and the likelihood of this occurring increases day by day. It is the businesses that are proactive in accepting the risk and taking steps to manage it who will be more robust. The purpose of auditing and protecting the integrity of the supply chain is to provide all stakeholders with peace of mind that what they are dealing with is authentic. The impact of having a supply chain compromised is too great for a business to ignore.

With origin fingerprinting, from product creation through distribution to the end consumer, each supplier can be assured they are part of a process that aims to keep transparency and consumer interests at the core of it. This auditing process can:

- Reduce risk exposure for directors and demonstrate good governance
- Deter fraud within the supply chain
- Mitigate the risk for supply chain partners
- Help exonerate innocent parties in a food fraud event
- Signal to consumers that the supply chain is robust
- Send the message that the brand and its products are worth protecting.

Businesses in the agricultural and food services industry have never faced greater pressures than they do today. Rapid technological development, volatile economic landscapes and changes in the earth's climate which affect – and sometimes destroy – agricultural yields all force the continual evolution of supply chains. As agribusiness continues to globalise, and supply chains span throughout countries, over continents and across the world, these chains become more complex.

While globalisation brings people together and fuels economic growth, it is also the reason that businesses have never faced greater risk. The pressure to lower prices now coincides with the need to protect the value of premium products, and products like New Zealand's mānuka honey are ultimately the most vulnerable to food fraud. Consumers are concerned with the provenance of their food, and demand proof of origin labelling from the brands they want. When consumer trust is broken, brands suffer sometimes irreparable damage to their reputation.

In the case of mānuka honey such fraudulence has broader implications for Brand NZ, tarnishing the reputation of the producers at the source who are responsible for the product, whether or not it was them who adulterated it. That is why taking the necessary steps to guarantee the integrity of their products is more important than ever for food services and supply companies, and why adding science to the supply chain is the way forward.

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