Track and trace

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Traceability is particularly important in the food processing industry because if something goes wrong there is a genuine risk that consumers may die. The root cause of any contamination needs to be identified and all affected food traced and removed from consumer access with all possible speed. A recall costs money. Big money. And then manufacturers also have to deal with the fallout of brand damage and possible litigation.
If producers and retailers can track their products all the way from farm to factory, and then into the retailer, then taking corrective action becomes a lot easier. Costs are automatically reduced as a result.

New, real-time technologies are making the tracking and tracing of foods much easier and they are no longer prohibitively expensive. Food processors can now use modern sensing and recording techniques and communication systems to gather data more accurately than ever before. So in the event that a food recall becomes necessary, processors can identify the source or cause of the problem and then trace where the contaminated foods are. Accurate data should ensure that the extent of the recall can be minimised without compromising public wellbeing.
As the length and complexity of food chains increases, so too does the potential for contamination. Having sound track-and-trace systems in place is imperative to protect both consumers and your brand.

Janette Woodhouse
Editor – *What's New in Food Technology and Manufacturing*

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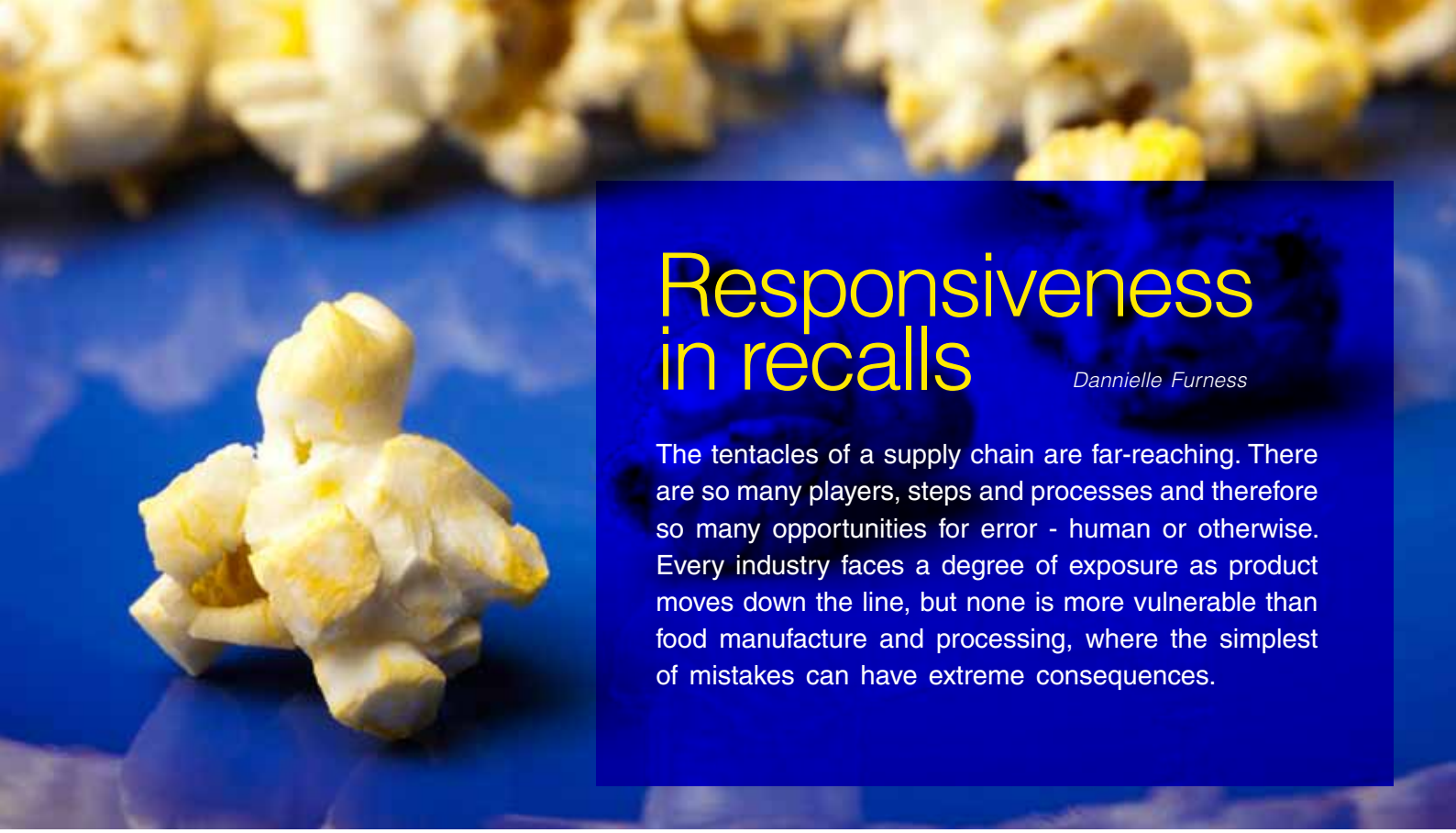

Responsiveness in recalls

Dannielle Furness

The tentacles of a supply chain are far-reaching. There are so many players, steps and processes and therefore so many opportunities for error - human or otherwise. Every industry faces a degree of exposure as product moves down the line, but none is more vulnerable than food manufacture and processing, where the simplest of mistakes can have extreme consequences.

Potential for error abounds in food processing; from inaccurate processing to incorrect supply. This could be direct human input such as an operator using the wrong mix in animal feed or merely checking the wrong item off a checklist. Inaccurate labelling can easily lead to supply of the unsuitable product and make tracing incredibly difficult. In the worst case, a failure in process can result in contaminated product reaching the consumer, conceivably creating widespread foodborne illness and even death.

Recall ramifications

In highly regulated industries such as food production, where there are ample measures in place to ensure that standards are maintained, the unthinkable can still occur. In recent years the Australian market has seen consumers contract ***Listeria*** through supply of contaminated cheese and smallgoods, as well as ***Salmonella Typhimurium*** from chicken meat and eggs, to name only a handful of widely publicised incidents. Products containing undeclared allergens are regularly recalled as they represent significant risk to consumers with sensitivities. At best, these outbreaks can cause reversible illness and, at worst, can result in death.

The implications arising from this type of incident go beyond the serious health risks. While not life-threatening, the financial ramifications of a recall for food suppliers can be enormous, as can the potential brand and reputation damage that follows. In the case of a food product recall, there is most definitely such a thing as 'bad' publicity. If government authorities and statutory bodies step in there can be penalties issued, and it's not uncommon to incur court costs as well if consumers become litigious. In all cases, the need to react swiftly and surely to minimise the effect is paramount.

According to the Australian Food and Grocery Council (AFGC) website: "The protection of the health and safety of consumers is a fundamental requirement and a legal obligation of all companies involved in the production and sale of food and grocery products." So it's pretty clear where the responsibility lies.

As an independent statutory agency, Food Standards Australia New Zealand (FSANZ) not only develops food standards but tracks product recalls with a view to identifying common trends and preventing further incidences.

FSANZ categorises food recalls under eight separate categories: microbial contamination; labelling; foreign matter; chemical/contaminant; undeclared allergen; biotoxin; tampering; and other. The agency holds data on all food product recalls dating back around 10 years and makes all of this information publicly available on their website.

The total number of recalls per annum has dropped significantly from 105 in 2003 to around 60 in 2012, but the data reveals that the top three offenders have remained the same over that 10-year period: microbial contamination (a total of 213 recalls from 2003-2012); undeclared allergen (206); and foreign matter (126).

Given the potentially fatal consequences of tainted product reaching the marketplace, a suitable system for tracking and tracing is not an extravagance, it is a business necessity. When it comes to recalls, the AFGC states: "While the supplier has absolute responsibility for the safety of its products, the removal of the product from the marketplace is a shared responsibility throughout the distribution chain." Guaranteeing delivery of non-harmful product means ensuring all suppliers

have checks and balances in place to act accordingly in the event of a recall. Not surprisingly, major food retailers insist on this as a requirement of their quality system.

Fast track action

An effective tracking and tracing program comprises a number of components, starting with accurate and fast identification. For years, the identification workhorse has been the ubiquitous barcode. As foodstuffs move through the production process, they are identified by a unique code; on containers when in process, on packaging for the finished product, on cartons and pallets during transport and on shelves when they finally hit retail stores.

In terms of final inventory, the numbers are staggering, with distribution centres across Australia accepting 10,000 pallets of goods a day in the case of one of the major grocery players. That's over 3.6 million pallets a year; each stacked two metres high with multiple products, all bearing their own barcode. A 2% inaccuracy rate would mean breaking down 73,000 pallets per year for manual handling and double-checking. Considering these sorts of numbers, the need for error-free tracking is pretty clear. In the event of incorrect labelling on contaminated items, finding the product is akin to the old 'needle in the haystack' adage.

SICK devices read barcodes and transmit that information elsewhere - specifically to a database, another crucial element in the system. Implementing cutting-edge code reader technology, known as 'Smart Decoder Technology', the readers pick up barcodes on fast-moving products with extreme reliability and minimal no-read rates. A reported 99.99% accuracy rate has been quoted by a supplier to one of the majors. This means overall improvement in the ability to deliver correctly coded product, which pre-existing technology simply couldn't read. In the event that an incorrect barcode is discovered, the device notifies a central database, which in turn initiates corrective action.

Beyond the barcode

RFID (radio frequency identification) is not a new concept, but it is increasingly found in food tracing as technology improves and prices come down. Implementation is not uncommon in the case of large containers containing raw products and in the mixing of bulk materials.

RFID tags offer more functionality than barcode technology, as they are read/write devices. Using the mixing of raw materials as an example, once an RF tag is attached to a hopper and that tag passes a reading station, the hopper is identified as present and information that is stored on the tag is read. The tag tells an operator which ingredients to use, how much of each is required and where those components are located within the storage facility. Once the process is complete, the tag is updated with additional information relating to the completed task before it passes through to the next stage. Product is not able to move down the line without verification. The use of RFID technology provides an advanced method for tracking and controlling the process mid-production, which is imperative in a situation where quick identification of contaminants introduced during manufacture is required.

The car industry has been utilising RFID for years, where a tag is attached to the car body and is encoded with options information for each vehicle. As the product moves through the assembly line, the operator is automatically advised on which options are required. These are implemented, verified and the vehicle moves down the line. While the process is essentially the same, application in the food industry is relatively recent.

Improvements have seen the cost come down from dollars to cents per unit, so beverage suppliers in Europe are using RFID extensively. The development of disposable tags has led to wine manufacturers including RFID technology on the bottom of every bottle. Individual presentation of each bottle is no longer required, as all bottles within range of an RF reader will be picked up. This delivers greater speed of reading individual products in consolidated shipments. In the case of a product recall, those products which are and are not affected on a fully stacked pallet can quickly be determined.

One piece of the puzzle

There is certainly room for both ID technologies in food production, as each has its own advantages and disadvantages. Some processes make one more suitable than the other; for example, RF tags can survive washdowns, which makes them a more likely choice for use with fresh produce items that are subjected to wash baths as part of the production process. In the short term, however, it's unlikely that RFID will replace conventional code reading entirely, as barcodes are low-cost, reliable and suited to a number of processes.

Regardless of the chosen technology, the ability to read the stored information quickly and accurately is still the key to minimising delays and to avoid double-checking. SICK readers (conventional barcode and RFID) are only one of the technologies required to provide an effective solution. A suitable software program (a one-up, one-down database, which identifies both supplier and receiver of a product) is required to complete the picture and SICK readers integrate with most available programs.

Minimising the impact

While the ultimate situation would be no need for product recalls, the reality is that they are often required. Minimising the impact should be a major focus of any food manufacturer's program of redress. This means planning ahead - knowing how the situation will be managed before it occurs is imperative. Having systems in place to identify the source of the problem and affected products quickly and efficiently can reduce the scale of the issue through faster containment, which additionally eases the financial burden associated with any required rectification. Finally, a process of assessment post-recall not only provides insight into 'what-went-wrong-where', but also an avenue for improvement in the event of future product withdrawals. ■

Traceability, accurate data and modern technologies

Real-time track-and-trace solutions can ensure that a food product is accurately tracked at every stage of the supply chain but this is only useful if the data is reliable, has been accurately gathered and has not been tampered with.

In the food industry the supply chain is frequently long and particularly complex. Just think about a hamburger: along with the meat there can be 20 other ingredients. Each of these needs its own traceability codes and the manufacturer is obliged to keep the inventory of all these codes. To these are added the codes related to the processing time, to the package, to the expiry time, to the containers in which the products have been carried, to the distribution places etc. To compound this, the purchasing of raw materials from a third-party supplier has to be based on mutual trust. There are no 100% reliable methods to control the content of all the merchandise all the time.

In 2011 the Institute of Food Technologists (IFT) led two pilot programs for the US Food and Drug Administration (FDA) designed to test and study various product tracing systems. The purpose of these pilots was to identify methods to rapidly and effectively trace food products throughout the supply chain so that, during a food-related outbreak, products could be quickly identified and removed from the marketplace, which would ultimately help minimise the number of consumers affected by a contaminated product. Various product tracing practices for fresh produce and processed foods were studied.

Tomatoes were selected for the fresh produce pilot and foods consisting of chicken, peanuts and/or spices were selected for the processed food pilot. Foods selected for the pilots had been associated with outbreaks between 2005 and 2010. Key findings from IFT's analysis of current product tracing practices indicate the following challenges associated with outbreak investigations:

- Tedious and difficult to sort through hundreds of pages of documents.
- Confusion when data definition is lacking.
- Inconsistent item descriptions.

- Wrong or incomplete information cause delays.
- Companies operating under multiple names are difficult to identify as sources.

IFT recommendations to the FDA included the following:

- Clearly identify the types of data that industry needs to provide during an outbreak investigations.
- Require each member of the food supply chain to develop, document and implement a product tracing plan.
- Pursue the adoption of a technology platform to allow the FDA to efficiently aggregate and analyse data reported in response to regulatory requests.
- Coordinate traceback investigations and develop response protocols between and among state and local health and regulatory agencies.
- Offer extensive outreach and education around future regulations and expectations.

It is anticipated that regulators will be able to resolve foodborne illness outbreaks earlier and the food industry to respond to them quicker if these recommendations are implemented. As a result, the public health impact of an outbreak will be greatly reduced as it has been shown that improved product tracing has the potential to reduce the public health impact in the US by up to 55% of total illnesses and reduce the economic impact by up to $14 million per outbreak.

The results of the pilots suggest that if a food company improves its ability to trace products, the company can expect to also achieve improved business processes, increase supply chain confidence and possibly expand their markets.

Many companies in the food industry consider product tracing a subset of supply chain operations, and product tracing may not be a dominant consideration when making investment decisions. However, the threat of not having product tracing capabilities in the event of a foodborne illness outbreak represents significant risks to a firm.

Technology enables better storage and tracking

Recent advancements in technology have made real-time recording of temperature and time possible - meaning that a case of tomatoes that sat in the sun after being picked would be the first off a semi, not the last. This can help limit food waste as supermarkets and distributors better understand the shelf life of produce.

These technologies are now so inexpensive that they can realistically be used by smaller scale food processors and farmers who need to be integrated into the distribution chain.

Enter RFID

The recent large-scale recalls of peanut butter and more than 100 related food items re-emphasises the need for an RFID-based track-and-trace system for the food industry.

Research firm IDTechEx says that the RFID market for food safety and animal tagging will grow from just over $1.1 billion in 2011 to more than $4 billion by 2021.

Clearly, food safety appears to be a sweet spot for the technology. Just as RFID provides increased inventory visibility for retailers, the technology can track food items in similar fashion, making food recalls easier to track and therefore limiting related illness. Big opportunities exist in the food supply chain from farm to fork, including monitoring temperature and humidity as food makes it way to retail outlets.

More than one-third of produce spoils before it reaches the shop shelf, representing an economic loss of an estimated $35 billion. RFID could put a big dent in that number.

The hope is that RFID and in-transit temperature monitoring can put a major dent in the $35 billion in annual waste by allowing food shippers to automatically monitor data and make proactive changes as simple as changing the routing destination of various pallets. The end result is that produce growers, distributors and retailers can avoid losses by utilising actionable data.

The insurance industry has typically shied away from the cold chain because of the lack of data, but with the new real-time data visibility that is achievable this need no longer be the case.

RFID in Canada

In Canada last year, CentrePort Canada and Invent IOT Technology unveiled an export tracking system to ensure the quality, integrity, origin and safety of agricultural products being shipped from central Canada to growing consumer markets in inland and western China.

The cargo security and tracking system utilised RFID technology that has been implemented by CentrePort Canada as part of a broader initiative to increase exports to China.

“This project is a breakthrough on several fronts,” said Diane Gray, president and CEO of CentrePort Canada. “It establishes a new supply platform for exporting goods to China, which means more sales and market opportunities for Manitoba and Canadian producers. And it provides an efficient, cost-effective RFID-tracking system to assure Chinese consumers that our products are high quality, authentic and safe.”

“The strategic collaboration between CentrePort Canada and Invent IOT Technology facilitates the development of Sino-Canadian trade, logistics and technology, ensuring the integrity of cargo

in transit. And this collaborative relationship enables realisation of tracking, tracing, verification and management of the supply chain of Canadian meat products from birth to slaughtering, distribution and sales, ensuring Chinese consumers can rest assured that Manitoba and Canadian meat products are safe, authentic and healthy," added Jack Sheng, president of Invent.

Invent IOT Technology developed the tracking technology, a passive RFID tag that is placed in the container as it is locked to ensure the integrity of the cargo along the supply chain. The RFID tag, which contains critical information about the cargo, is read at origin with the captured information sent to a back-office system. The RFID tag is read again at destination and the information retrieved must match the originating information. The RFID system can be accessed through a portal on CentrePort's website.

"This new RFID system will only help enhance Manitoba and Canada's reputation for exporting safe, high-quality food products by providing the security and assurances that China is seeking," Gray said, noting that product tampering, cleanliness, counterfeiting and the misuse of chemicals are some of the issues China continues to face.

As part of the RFID project, CentrePort signed an MOU with Quingdao Port in China, which is installing overhead RFID readers to track the Canadian cargo as it enters the country. Gray said now that the supply platform and RFID-tracking system have been established, CentrePort will be working with Manitoba and Canadian agricultural producers to identify food products that can be exported to China.

RFID in Europe

Similarly, the European Commission-sponsored Farm to Fork initiative seeks to offer small to medium food producers in Europe the ability to benefit by deploying RFID. By linking RFID and sensor network technologies with a Europe-wide database that contains the exact history of any food product, SMEs will be given the opportunity to optimise their own business process and maximise return.

In addition, a pan-union resource will be created that will allow producers to demonstrate unequivocally the quality and freshness of their product, which will have the effect both of increasing consumer confidence and increasing producer margins.

With RFID technology embedded into their value chain, SMEs can benefit from improved worker productivity and efficiency, a reduction in labour costs, fast quality problems detection by monitoring environmental variables, more efficient control of the supply chain due to increased information accuracy and a reduction of human errors from manual scanning operations.

Farm to Fork has completed several pilots in the meat, dairy, wine and fish categories.

It's clear that tracking and monitoring the condition of products from the producer to the consumer is becoming increasingly critical and that modern technologies can accurately gather the necessary information and disseminate in real time to ensure consumer safety as well as maximise product quality. ■

A safer food chain for Europe

As food chains become ever more global in scope, the origin, safety and quality of the food we eat is becoming an increasingly major concern for consumers and the food industry alike. However, over the last 10 years, an integrated approach to food safety research in Europe has yielded positive results for the food industry.

A lot can change in 10 years

Ten years ago, Europe was still shaking from the 1999 Dioxin contamination scandal, the Bovine spongiform encephalopathy crisis and an increasing number of microbial food contamination health scares.

These food crises highlighted the need for models and detection systems to prevent contamination of the food chain and led to the 2002 EU General Food Law Regulation that made it compulsory for one step up/down traceability systems to be operational in the food industry, making individual producers accountable for traceability in the food chain. The European Parliament specifically requested that the Sixth Framework Programme (FP6) dedicate part of its research budget to food traceability and integrity to support this policy, which it did to the tune of EUR 98 million.

The research coordinators from 14 individual FP6 projects worked together over a 2-year period to formulate a novel dissemination strategy for their results, which covered the complete spectrum of the traceability sector, a groundbreaking move that EU Commissioner for Research and Innovation Márie Geoghegan-Quinn describes as part of an approach designed to address the "need to improve the dissemination of finished EU research projects".

The projects all set out to address origin and traceability issues by making sure consumers can be sure that food really comes from where it says it comes from.

Consumers want to know that what they are eating is safe and that it really is what it says it is.

Beyond the scientific results produced collectively by the projects, there were also clear additional benefits in terms of educational opportunities, mobility, industrial support, integration and dissemination, as illustrated by 100 PhD and 40 Masters degrees, 350 external and internal reports, 28 International Scientific Cooperation

(INCO) activities partners, 30 international meetings, 150 EU meetings and169 mobility transfers across different laboratories.

The projects also had a 29% female management structure, made links with 84 industrial partners, held 98 industrial workshops, published 696 peer-reviewed scientific papers and had seven patents granted.

The Integrated Project (IP) TRACEBACK (Integrated system for a reliable traceability of food supply chains) focused on food origin, creating a system that establishes an information link from a product's raw material stage to its eventual sale.

As well as improving health and safety standards for the consumer, this method also allows industry players to trace their product and gauge its quality along the chain of production, manufacturing, handling, transportation and distribution. The TRACEBACK system therefore helps producers meet industry requirements and EU regulations.

Another traceability project that developed robust techniques to identify, rank and assess vulnerabilities in the food chain was TRACE (Tracing the origin of food). The aim of TRACE was to help consumers better know where their food comes from by giving them confidence in food labelling. For producers of regional specialities like Parma ham or Feta cheese who want to be sure that imitators cannot make false claims of origin, this work is incredibly important. There are ways to detect the origin of a particular foodstuff based on technical methods and these can also be used in the event of a major fraud case.

"TRACE had close working relationships with all the major research activities on food traceability and authenticity," comments TRACE project coordinator Paul Brereton, Head of Food and Health Research at The Food and Environment Research Agency in the United Kingdom.

"A large part of TRACEBACK concerned demonstration of technology for tracking, tracing and verifying authenticity and quality labelling of food, and as such it was very complimentary to TRACE. TRACE members sat on the TRACEBACK advisory and evaluation panels and joint meetings were held on several cross-cutting issues."

Paul Brereton also says that reducing duplication and maximising resources are two of the benefits of collaboration among coordinators working on EU-funded research projects in the same field.

Another important aspect of traceability is biotraceability, which involves going beyond working out where food comes from but also pinpointing exactly where contamination happened. The BIOTRACER (Improved bio-traceability of unintended microorganisms and their substances in food and feed chains) project developed a way to point to materials, processes or actions within a particular food chain that can be identified as the source of undesirable agents. Bio-tracing has been improved significantly by better access to more comprehensive data supplies.

Co-Extra (GM and non-GM supply chains: their CO-EXistence and TRAceability), which brought together 52 partner institutions from 18 countries, was one project that addressed the co-existence and traceability of GM and non-GM products. The project coordinators report that while genetically modified organisms (GMOs) authorised in another jurisdiction only pose minor problems, it is GMOs that are not authorised under any jurisdiction at all that pose the most problems as they have unknown risks to health and the environment.

It was hoped that this research investment would result in Europe leading the world in best practice food traceability and that the implementation of the diverse results would ultimately boost consumer confidence and reduce the economic and social impact of food safety scares.

How do you measure success?

The salad crisis

In May 2011, an outbreak of gastroenteritis was identified by German officials. As soon as it was identified the hunt was on to find the source of the outbreak and to limit the risk of illness in the population. The first suspect identified was cucumbers from Spain.

Immediately consumers were told to dispose of cucumbers and, just to be safe, tomatoes and lettuces, from Spain. Consumption of salad vegetables took an immediate dive and fresh produce ended up in landfill all over Europe.

Ultimately, the cause of the outbreak was found to be fenugreek sprouts - not cucumbers at all. So how did the Germans get it so wrong? How did they come to blame the innocent cucumber and, as a consequence, devastate the entire salad produce market in Europe?

This outbreak of foodborne illness was not mild and not typical. By the end of July 2011, a total of 3816 cases including 54 deaths and 845 incidents of haemolytic-uremic syndrome (HUS) had been reported. The incidence of HUS at 22% was unusually high. Also, those affected did not follow the typical trends where children and the immune-compromised are most likely to be affected. In this outbreak adults, especially women, were being affected.

As cases of gastroenteritis were reported, following standard protocol, sufferers were ques-

tioned about what they had consumed. Among case subjects, 88% reported having eaten cucumbers while only 25% reported having eaten sprouts. Cucumbers were assumed to be the source of the disease and public warnings issued.

Following an extensive matched case-control study and a recipe-based restaurant cohort study, along with environmental, trace-back and trace-forward investigations, sprout consumption explained 100% of cases. The problem was that consumers didn't recall eating sprouts as readily as they recalled eating cucumbers.

In future foodborne illness outbreaks, consideration will have to be given to food items that consumers are less likely to remember.

The horsemeat scandal

Horsemeat is believed to have been used in 4.5 million ready meals in 13 European countries. As a consequence of this substitution scandal, international food manufacturers like Findus, Birds Eye United Kingdom, Nestlé and even Ikea have had to withdraw their meat products from the market.

The safety of their ready meals was not questioned - they were, and are, safe but consumers were not amused at being sold horse for beef. And now there will be ongoing costs for brand owners as they rebuild consumer trust in their ready meals.

In most cases the brand owners are victims - the ingredients and the provenance of the ingredients they specified was simply not what was delivered.

According to the French agriculture ministry, there was "serious, precise and corroborating evidence of a consumer fraud at a European level".

The whole fiasco has brought into light two particular areas - traceability and supply chain complexity.

In the first instance, traceability, the results are pretty good. The products were traced back pretty well. The problem was that the products were not what they were supposed to be.

On the other hand, the complexity of the European (and undoubtedly most other) supply chain was amazing.

The longer the chain, the higher is the risk of integrity breakdown as each step on the chain wants to make a profit on the trade. The actual money available for the ingredient becomes lower and lower the longer the supply chain. This is especially true for ready meals, which are frequently aimed at the 'economy' market. When retailers in the UK are selling ready meals for AU$1.50 per serve, there is huge impetus to purchase the meat as cheaply as possible.

In many ways the low cost of the ready meal to the consumer fuels the potential for (but does not excuse) opportunistic behaviour along the supply chain. Australia and New Zealand are not immune from the same pressures and behaviour. The self-regulated auditing model inherent in FSANZ Standard 3.2.1 is great for food safety but does not offer protection against corruption and fraud.

Now to mitigate the risks, everyone is testing their products for horse and horse-like (donkey, ass etc) contamination. However, this basically means no one is going to try passing off horse as beef anymore as they know the substitution will be detected. So processors and brand-owners are going to have to test for whatever the next substitution fraud will be. They only need to guess what to test for! ■

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