

# NEW FOOD



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Patent filing and cannabis edibles: a look at the opportunities still to be exploited

Extending shelf life of food products using the latest plant-based materials

As Brexit fast approaches, what can Mexico teach UK food businesses?

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# Opportunity knocks

While there are undoubtedly challenges ahead, there are plenty of innovations to be explored and chances to be taken, too.



**ANNA LAMBERT**  
EDITOR

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THERE'S NO DENYING that we're in the middle of uncertain times but, to follow the theme of Rob Chester of NSF's article on technology in this issue, it's time to walk the walk as well as talking the talk. Rob reminds us what blockchain has to offer the F&B sector and urges key players to harness its potential, to the benefit not only of their businesses but the wider food-supply chain, too.


Still on the theme of opportunities to be seized, Paul Bremner of PatSnap looks at what the data on recent patent filings can tell us about current commitment to the cannabis edibles market. He reveals which F&B manufacturers are already enjoying a piece of the action in this fast-growing sector and which stand poised to join in. He also assesses the scientific opportunities that

should be explored by any company wanting to stay ahead of the game.

There are opportunities aplenty, too, within the world of shelf-life extension. As consumers become more health conscious and the demand for 'clean-label' ingredients continues to rise, the food industry is racing to come up with novel technologies to make food safe from spoilage for longer time frames, and without compromising on the quality or flavour of that food. Paula Hock and Navneeta Kaul look at recent developments within this field, including some particularly exciting plant-based solutions.

With growing concern surrounding the health implications of eating processed meat, we feature fascinating research from Hanne Christine Bertram and colleagues at the Department of Food Science, Aarhus University, Denmark. They've been exploring hybridised meat products, which see plant-derived ingredients added to the traditional mix, and nutri-functionality by metabolomics. The good news is that innovations in the meat-product sector could see the nutritional profile of the humble hotdog sausage improved as a matter of course.

We've even managed – despite the uncertainty that continues even as we go to press – to find a positive angle on the dreaded 'B' word. With Brexit less than two months away, Jessica Calderón from The University of Sheffield looks at what agri-food companies in the UK might be able to learn from Mexico's experience in the wake of the US threat to abandon the North American Free Trade Agreement.

With opportunities abounding, we'd love to hear from you if your business or organisation is rising to particular challenges in an innovative way. As ever, we welcome research and case studies, so do get in touch if you have stories to share. 

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## A food system that works for everyone

With the need to deliver healthy, sustainable and socially equitable diets for the global population an imperative, *Anna Taylor* outlines what her organisation, the Food Foundation, is doing to help make it happen.

**T**he global food system has reached crisis point. In many corners of the world, the systems we've developed to feed ourselves have evolved into a highly efficient, hi-tech, profitable and interconnected web of companies that put appealing food on our tables at low prices. But the damage we are doing to human and planetary health is becoming increasingly severe, and it's essential that we take action to reform the food system so that it delivers healthy, sustainable and socially equitable diets for the global population.

The Food Foundation is an independent think tank, founded in 2015 to examine the UK food system and learn from international practices, unpicking the underlying policy reasons for their failure to deliver the necessary public goods. The Foundation is tasked with providing clear analysis of the food system and developing food policies that support and guide the public to make choices that improve their health and well-being. We work with a huge range of partners to engage industry, government and the public in order to work together to identify and implement solutions.

Recently, the Food Foundation has been prioritising increased vegetable consumption in the UK. The evidence shows that most of us know we should be eating more fruit and vegetables, but the reality is that one in four secondary school children and 13 percent of primary school children are eating less than a portion a day (Veg facts 2016). The health implications are stark: diets that are low in veg are associated with more than 20,000 premature deaths across the UK (IHME 2015) and eating one more portion of veg and a little less meat could reduce our greenhouse gas emissions by almost a fifth.

We have created Peas Please – a system-wide initiative to drive action across the supply chain in favour of increased veg consumption. We also



**ANNA TAYLOR** joined the Food Foundation as its first Executive Director at the beginning of June 2015 after five years leading the policy team on nutrition at the Department for International Development. Anna holds an MSc in Human Nutrition and has held roles at Save the Children, UNICEF and on the GLA's London Food Board.


“*The majority of advertising spend on food and drink goes on foods high in fat, salt and sugar, with only 2.5 percent going on fruit and vegetables*”

know that advertising is a powerful tool, and that, currently, the majority of advertising spend on food and drink goes on foods high in fat, sugar and salt, with only 2.5 percent going on fruit and vegetables. 'Eat Them To Defeat Them' is an exciting new advertising campaign hoping to energise and inspire children across the UK to eat their veggies (see it at [www.vegpower.org.uk](http://www.vegpower.org.uk)).

But healthy diets are also an issue of inequality. We know that those on the lowest incomes have the least access to fruit and vegetables. That's why we've been working to tackle children's food insecurity, leading the Children's Future Food Inquiry (spearheaded by a parliamentary committee) in its efforts to understand and improve the situation for the millions of children who don't have access to enough nutritious food.

There's also plenty to learn from international food systems, and the Food Foundation is currently facilitating the 'Nutrition Smart City' initiative, working to develop policies and practices through a partnership between Birmingham, UK and Pune, India.

Elsewhere, the Food Foundation is working with a range of organisations on the Sustainable and Healthy Food Systems (SHEFS) programme; a research project that examines the interactions between food, health and the environment in the UK, India and South Africa. The programme aims to provide policy makers with novel, interdisciplinary evidence to define future food system policies that deliver nutritious and healthy foods in an environmentally sustainable and socially equitable manner.

The task of addressing the great need for rebalancing the food system so that making the healthy choice is the easiest choice will require mammoth efforts from the Government, businesses and members of the public. The solutions are there, but we all have a lot to do! 

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# ROUND UP

The editor's pick of the most interesting developments within the food and beverage industry



## Rising temperatures could secure crop nutrition but at expense of yield, field trials show

### SUSTAINABILITY

A NEW study in *Plant Journal* from the University of Illinois, US Department of Agriculture Agricultural Research Service (USDA-ARS), and Donald Danforth Plant Science Center suggests that rising temperatures may actually benefit nutrition but at the expense of lower yields.

Two years of field trials show that increasing temperatures by about 3°C may help preserve seed quality, offsetting the effects of carbon dioxide that make food less nutritious. In soybeans, elevated carbon dioxide levels decreased the amount of iron and zinc in the seed by about eight to nine percent, but increased temperatures had the opposite effect.

"Iron and zinc are essential for both plant and human health," said Ivan Baxter, the Principal Investigator at the Danforth Center. "Plants have multiple processes that affect the accumulation of these elements in the seeds, and environmental factors can influence these processes in different ways, making it very hard to predict how our changing climate will affect our food."

"This study shows that a trade-off between optimising yields for global change and seed nutritional quality may exist," said co-principal investigator Dr Carl Bernacchi, a scientist at the USDA-ARS, which funded the research along with the USDA National Institute of Food and Agriculture.

## Canada rethinks its healthy eating advice with revised Food Guide

### NUTRITION

CANADIANS HAVE been reacting to the latest edition of the nation's Food Guide. Originally known when it was first introduced in 1942 as The Official Food Rules, it was devised to provide advice to Canadians on proper nutrition as they grappled with wartime rations.

With the new Food Guide recommending eating "plenty of vegetables and fruits, whole grain foods and protein foods" and advising Canadians to, "choose protein foods that come from plants more often," it has – unsurprisingly – been less enthusiastically received by the nation's meat producers. "We would question whether it's actually

true that plant-based protein is better for you than an animal-based protein," Tom Lynch-Staunton, Alberta Beef Producers' government, relations and policy advisor, told Edmonton AM, as reported on the CBC website.

Meanwhile, Dairy Farmers of Canada, reacting to lack of emphasis on dairy with the Guide, have also expressed their concern, "...that the updated Food Guide does not reflect the most recent and mounting scientific evidence available. There is abundant research that demonstrates that milk products with various fat content can be a part of a healthy diet."

## Stability for food prices in December 2018, according to FAO

### COMMODITIES

GLOBAL FOOD prices held broadly stable in December 2018, with rising international cereal prices offsetting declining sugar and dairy quotations, the Food and Agriculture Organization of the United Nations (FAO) says.

The FAO Cereal Price Index increased by 1.8 percent in December from November and 9.6 percent from December 2017. Wheat and maize prices rose during the month, due to weather effects in the southern hemisphere, while rice prices declined for the sixth successive month. FAO's most recent forecasts anticipate global output of wheat and maize to fall in 2018 while that of rice to set a new record. Global suppliers of all the major cereals are more than sufficient and inventories are still ample, says the FAO.

The FAO Vegetable Oil Price Index rose by 0.4 percent in December, ending ten consecutive months of decline, led by a rebound in palm oil prices. International soy oil prices continued to drift

downward, impacted by ample supplies in the United States and weak demand in the European Union.

The FAO Meat Price Index posted an 0.8 percent increase during the month, led by a recovery in pigmeat prices, which were supported by strong global import demand, especially from Brazil. The index was down 2.2 percent on an annual basis.

The FAO Dairy Price Index declined by 3.3 percent from November, marking its seventh successive monthly drop, led by lower price quotations for butter, cheese and whole milk powder.

The FAO Sugar Price Index fell by 1.9 percent in the month, in part due to reportedly faster sugar production growth in India and in part to falling international prices of crude oil, which lower the demand for sugarcane to produce ethanol while boosting supplies for the production of sugar, notably in Brazil, the world's largest producer.





## EU food safety system overstretched, say auditors

### FOOD SAFETY

A REPORT on chemical hazards in foods has concluded that the European Commission and Member States do not have the capacity to implement food safety fully.

Although the EU's system for protecting consumers from chemical hazards in food is soundly based and respected worldwide, it is currently overstretched, according to a new report from the European Court of Auditors. The European Commission and Member States do not have the capacity to implement the system fully, the auditors say.

EU food safety policy aims to guarantee a high level of protection for human life and health, and was designed to protect EU citizens

from three types of hazards in food: physical, biological and chemical. In particular, the latest audit concentrated on chemical hazards.

The legal framework governing chemicals in food, feed, plants and live animals remains a work in progress, the auditors report concluded, and has not yet been implemented to the level envisaged in EU laws governing food production. The report also said that the European Food Safety Authority, which provides scientific advice to inform European policymaking, suffers backlogs in its work in connection with chemicals. This affects the proper functioning of parts of the system and the sustainability of the model as a whole, says the report.



## Sixty percent of wild coffee threatened with extinction, says research

### SUSTAINABILITY

FOR THE first time ever, scientists at Royal Botanic Gardens, Kew have carried out an International Union for Conservation of Nature (IUCN) Red List of Threatened Species assessment for all 124 coffee species. The research, just published in *Science Advances* and *Global Change Biology*, reveals that 60 percent of all wild coffee species are under threat of extinction due to deforestation, climate change, and the increasing severity and spread of fungal pathogens and pests. This includes the wild relative of *Coffea arabica*, the world's favourite and most widely traded coffee, which has entered The IUCN Red List as an Endangered species, largely due to climate change projections.

These new figures come after two decades of dedicated research undertaken by Kew to discover, analyse and document the world's coffee species, and assess their extinction risk.

Says a spokesman for the team, "The results of the research, showing that 60 percent of all coffee species are threatened with extinction, is an extremely concerning outcome. The multi-billion-dollar coffee sector is founded on, and has been sustained through, the use of wild coffee species. Included among the 60 percent under threat of extinction are those that could be key to the future of coffee production. The global coffee trade currently relies on only two species – Arabica (c. 60 percent) and Robusta (c. 40 percent) – but given the myriad of emerging and worsening threats to coffee farming globally, other coffee species are likely to be required for coffee crop plant development."

## Project aims to tackle Australian steak fraud

### TECHNOLOGY

THREE TONNES of Australian beef packed in Casino NSW, Australia, and bound for China is being tracked and verified using blockchain and Internet of Things technologies.

The shipment is the first in a Food Agility project, led by Queensland company BeefLedger and Queensland University of Technology. It aims to stamp out the problem of 'fake steak' in international export markets, giving suppliers and consumers confidence that their meat is 100 percent Australian.

The team is building a digital system using 'smart contracts' to replace forgeable letters of credit, developing and integrating a suite of technologies into new packaging to prevent the substitution of fake products, and building apps for consumers and suppliers so they can verify where their meat comes from.

Food Agility CEO, Dr Mike Briers, says food fraud is a growing concern as the demand for Australian beef in markets such as China, outstrips supply.

"'Fake steak' is costing Australian producers millions, putting the health of consumers at risk and damaging the Australian brand. Crypto-technologies like blockchain create an unbreakable, immutable record, tracking a product from paddock to plate, credentialing the provenance of the produce, and giving confidence to consumers," says Dr Briers.

BeefLedger builds connected supply chain systems for the beef industry. Chair, Warwick Powell, says the new technologies do much more than track provenance and will be a game-changer for the food industry.

"We can secure data to track the conditions of transport, more accurately predict shelf-life and use-by dates and connect consumers with producers," says Warwick Powell.

"We can also encourage members of the supply chain to do the right thing by offering economic incentives through newly established cryptocurrencies and latest insights from behavioural economics."



# Improved Quality Assurance through TOC Analysis for Cleaning Verification

Total organic carbon (TOC) analysis is a simple, effective tool for cleaning verification and process control. TOC analysis enables companies to operate more efficiently, prevent product loss, and improve quality control. Monitoring the effectiveness of a cleaning process on shared equipment trains is extremely important for safety and quality.

TOC analysis of rinse samples can be implemented to effectively detect any residual products or cleaning agents that remain on equipment. It can also help detect microbial contamination on equipment surfaces that may pass visual inspection but still present safety risks. For many companies, monitoring the cleaning process effectiveness through TOC prevents failed attempts to sterilise dirty equipment, not only saving time and money, but also ensuring the quality of the next product.

In his informative presentation, which took place on 8 December 2018, Lukas Swanson, Global Life Science Applications Engineer, SUEZ, explained how TOC analysis works, examined best practices for its use and outlined case studies. Lukas also answered questions from registrants, including the following:

## What are the limits of detection for TOC analysers?

The limits for a Sievers M9

TOC Analyser are 0.03 parts per billion (ppb) to 50 parts per million (ppm).

## How do I know if my cleaning samples will be in those limits?

If you have never analytically quantitated your cleaning samples before, we can help. We have an applications support laboratory that can run customer samples to help determine if our analyser is appropriate for your application.

## Can you describe how conductivity can be used for cleaning samples?

Conductivity in conjunction with TOC spans nearly the entire array of potential compounds and contaminants that will be found in a food and beverage process. The conductivity measurement can detect the presence of any ionic species, including inorganic ionic species such as salts or inorganic acids and bases.

## Can you clarify how turbo mode can be beneficial for rinse samples?

Turbo mode is a feature on the Sievers M9 TOC Analyser that enables real-time monitoring of the cleaning process. By utilising Turbo for rinse samples, you will know immediately when your process has effectively cleaned your equipment.


## Do you recommend adding TOC to a cleaning program only when you think are near limits of visual inspection?

Yes. I would recommend TOC for any cleaning program, regardless of the proximity of process capability to the limits of visual inspection. The reason for this is for gaining process understanding. With quantitative data on the effectiveness of your cleaning process, you can now know when a deviation is occurring without the subjectivity of visual limits or the inability to detect it at all.

## How commonly is TOC used in food & beverage industry?

Quantitative measurements within the food & beverage Industry are becoming almost standardised regardless of scale. Current good manufacturing practices from other industries, such as pharmaceuticals, are making their way into the food & beverage industry because of the benefits for quality, traceability, and process control. We see our solution implemented in the food & beverage Industry at an increasing rate year over year.

## Is it possible to embed the TOC Analyser within a third-party CIP system?

Yes, absolutely. We work closely with our customers and CIP skid manufacturers to help integrate our analysers into any setup the customer may require. 

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# From concept to reality – The **challenge** for **2019**



**Rob Chester**, Managing Director of Food at NSF International in the UK, considers how much progress we have made with technology, specifically blockchain, for food safety in the last year and advises that we need to stop talking the talk and start walking the walk.

**T**HIS TIME last year, in this magazine, I argued that we have to change the way we look at food safety. I examined the ways in which technology could potentially revolutionise our work in the light of some stark facts. Overall food safety has not improved over the years, with just as many, if not more, people getting sick and dying of foodborne illness than decades ago. Our food safety regulation system is scarcely keeping up with innovative products and ways of working, and resources are increasingly stretched under the burden of ever-more exacting challenges from regulators, customers and consumers.

Consumer trust has been severely eroded, with the Russell Hume and 2 Sisters scandals in 2017 followed in 2018 by turkey and pork being found in 'meat-free' and 'vegan' supermarket ready meals, much to the dismay of Muslim, Jewish and vegan customers. We also saw a huge *E. coli* outbreak in US fresh produce, which affected 197 people across five states, and listeria in Australian melons.

The standard response to these issues has always been 'more audits' but we cannot carry on simply doing more audits when things go wrong

or in the hope of catching a growing array of potential problems. Remote auditing services help to take some of the cost out of inspection, and smart phones and automatic pre-load of data contribute to efficiency of audit on site. But are there more effective solutions out there? I for one believe that there are some circumstances in which nothing can replace a physical audit, and many regulators agree. There is nothing like an experienced auditor casting an eye over the site and looking the operator square in the face. Most food safety failures are caused by human behaviour – intentional or otherwise – and, as far as I know, there is not yet any automated process that can make a fine, subjective assessment of the human risk posed. That said, there are genuine alternatives to audit – depending on what problem we are trying to solve. Blockchain offers us huge potential here.

### **Blockchain: the silver bullet?**

"Oh no, not blockchain again", I hear you say. Blockchain has been touted as the panacea to most modern ills, and applied theoretically as a solution ►



**“ I for one believe that there are some circumstances in which nothing can replace a physical audit, and many regulators agree ”**

to just about all commercial, legal and contractual challenges. The beauty of blockchain is threefold: it provides a secure locked-down and incorruptible inventory of data and transactions, data in a blockchain can be entered once and shared multiple times with anyone who has the permissions, and it is rules-based and, once set up, can automatically transact and record without the need for a middleman or controlling authority. A good example of this would be that the blockchain system can be programmed to order more warehouse stock automatically when call-offs reach a certain level. You can think of it as an autonomous vehicle that is pre-programmed to get to its destination.

So, within the food safety arena, blockchain can securely record and automatically share things like automatic digital fridge or oven temperatures, movement records of livestock, produce sales and transactions. In certain areas of regulation, for example in farming, which is regulated in the UK by Defra and five agencies with overlapping responsibilities, a significant burden of red tape could be removed simply by using a blockchain system to avoid the necessity of duplicating the same piece of data numerous times. This is something that is indeed under consideration.

### **Blockchain: has anyone done it?**

However, let's face it, has anyone outside of bitcoin and other crypto-currencies really implemented a large-scale blockchain solution in a meaningful way?

Walmart has been working on this for over two years and along with nine other companies has partnered with IBM to develop a blockchain for tracking food globally through its supply chain. The Food Trust blockchain includes Nestlé SA, Dole Food Co., Driscoll's Inc., Golden State Foods, Kroger Co., McCormick and Co., McLane Co., Tyson Foods Inc. and Unilever NV. Trials began some time ago.

This is a great initiative with the aim of improving traceability so that in the event of recalls or disease outbreaks, the product can be tracked back to source in seconds rather than days. However, we have yet to see it fully in action.

The consulting firm McKinsey & Company reported in January this year that, in reality, there has been little uptake of blockchain in a scenario that's like the emperor's new clothes. It seems to be an amazing solution for many things, until it is revealed as what it really is – a largely untested tool. "Evidence for a practical scalable use for blockchain is thin on the ground," say McKinsey.

The feature goes on to say: "the stuttering blockchain development path is not entirely surprising [since] it is an infant technology that is relatively unstable, expensive, and complex." And that while blockchain has practical value in terms of niche applications, modernisation and as a way to demonstrate the ability to innovate, it may in fact be an inappropriate and overly complex solution in many applications. It is noted however that blockchain "brings benefits where it shifts ownership from corporations to consumers." And that, for me, is the key that unlocks its value.

### **How can blockchain create consumer trust?**

So why should we persist with blockchain? To think of blockchain as the solution to all problems is to miss the point. We have to understand what the problem is first and then think about what the appropriate solution might be. I come back to one of the biggest problems we face as an industry – the vexed issue of consumer trust. Why don't consumers trust us? Well, there are the obvious reasons I've mentioned above. The industry has made strenuous efforts to reinforce the traceability and transparency of the product from source to shelf, but has let the consumer down time and again because the task, especially in the protein

## ABOUT THE AUTHOR



**BEFORE JOINING NSF,** Rob Chester worked for Walmart in the UK, the US and China. While in China he was the Chief Compliance Officer and in the US he ran Operations Compliance across Walmart's 5,000 US stores. Prior to Walmart he held several compliance roles globally for Tesco. He holds an LLB and Postgraduate Diploma in legal practice from UCLAN in the UK.


chain, is so difficult. Traceability as it exists now is almost entirely retrospective and is not transparent to the consumer.

Over and above this, we have to face the reality that we live in a changing world. Michael Gove, the UK's Secretary of State for Environment, Food and Rural Affairs, boldly stated "I think that the people of this country have had enough of experts from organisations with acronyms saying that they know what is best and getting it consistently wrong." In these days of the information society and social media, consumers no longer rely so much on narrow subject matter experts and are far more likely to trust their own judgment and that of other people as well as their practical experience. Customers today prefer to see the balcony view they would get from their room before they book a vacation hotel room, get the seat view for their orchestra ticket, know the name of the employee who baked their Domino's Pizza and so on. This level of transparency increases trust and builds a connected community. There is no place for secrecy and little respect for confidentiality, except in so far as it affects their own personal information.

Blockchain is capable of providing this transparency, through a simple QR code on the

pack that gives the shopper instant access to whatever detail they want, right down to the birthdate of the animal. This may not be possible now but it certainly is in the longer term. For it to work, the system has to be large-scale and embrace the entire supply chain, including multiple suppliers, intermediaries, transport, warehousing, processing, etc. This is an enormous challenge, but I believe do-able with the right mind-set and by the right people.

I also believe that the ambition for blockchain has been set too narrowly if it is regarded simply as a traceability tool for business. Its real value is in providing the consumer with information that differentiates the product in terms of provenance, sustainability, environmental and welfare factors. The consumer can meet and trust the farmer in a way that is like a virtual handshake. That is the level of data that we need and it will add value to UK produce at home and in trading overseas. With Brexit on our doorstep, never has this need been greater.

So my challenge for 2019 is to throw down the gauntlet and ask who in the food industry will be first to turn the concept of blockchain into a usable and valuable reality? The time for talking is over. Now is the time for action. 

**“Blockchain can securely record and automatically share things like automatic digital fridge or oven temperatures, movement records of livestock, produce sales and transactions”**

## Measurement on the production line in food manufacture isn't easy

**On-line measurement in food production is often far from straightforward because of the many variations that can occur within the production set-up. These range from different raw materials, seasonal changes and process variations to the different behaviours of each person who operates the system.**

ON-LINE MEASUREMENT in food production is often not as simple as it could be. There are many variations to bear in mind within the production set-up, from different raw materials, seasonality changes and process variations to the different behaviours of each person who operates that system.

Quality controllers and production managers face a multitude of challenges when overseeing food production. It may not be possible to trim quickly, or to check procedures during cleaning or once production has stopped. Additionally, the operator needs to be able to react quickly to any changes in production as soon as those changes occur –

something that, again, is not always possible. Meanwhile, the pressure to meet production targets can lead to corner-cutting, meaning under utilisation of raw materials – at worst leading to failure to comply with specification limits and regulations.

That's why a speedy response is essential for successful quality control today. A fast trim at start-up and after production has two major advantages: it means less reworking and waste and takes less time, thereby ensuring better utilisation of production capacity. Moreover, being able to react quickly to changes in the process allows for optimal utilisation of resources. In turn, optimal utilisation of raw materials

can mean greater value from the production process. This helps to ensure that production meets specification requirements, thus avoiding legislative fines and the need to repeat tasks.

Q-Interline, a high-tech manufacturing company from Denmark, offers online Near Infrared measurement solutions that can be quickly and easily integrated to supply valuable, real-time information about the production process. By analysing each customer's production process individually, the team of Q-Interline can establish a bespoke plan for organisation and implementation of online NIR measurement equipment. ■

### EXPERTVIEW



**Martin Roithner Henriksen**  
CEO, Q-Interline

***“Optimal utilisation of raw materials can mean greater value from the production process. This helps to ensure that production meets specification requirements”***



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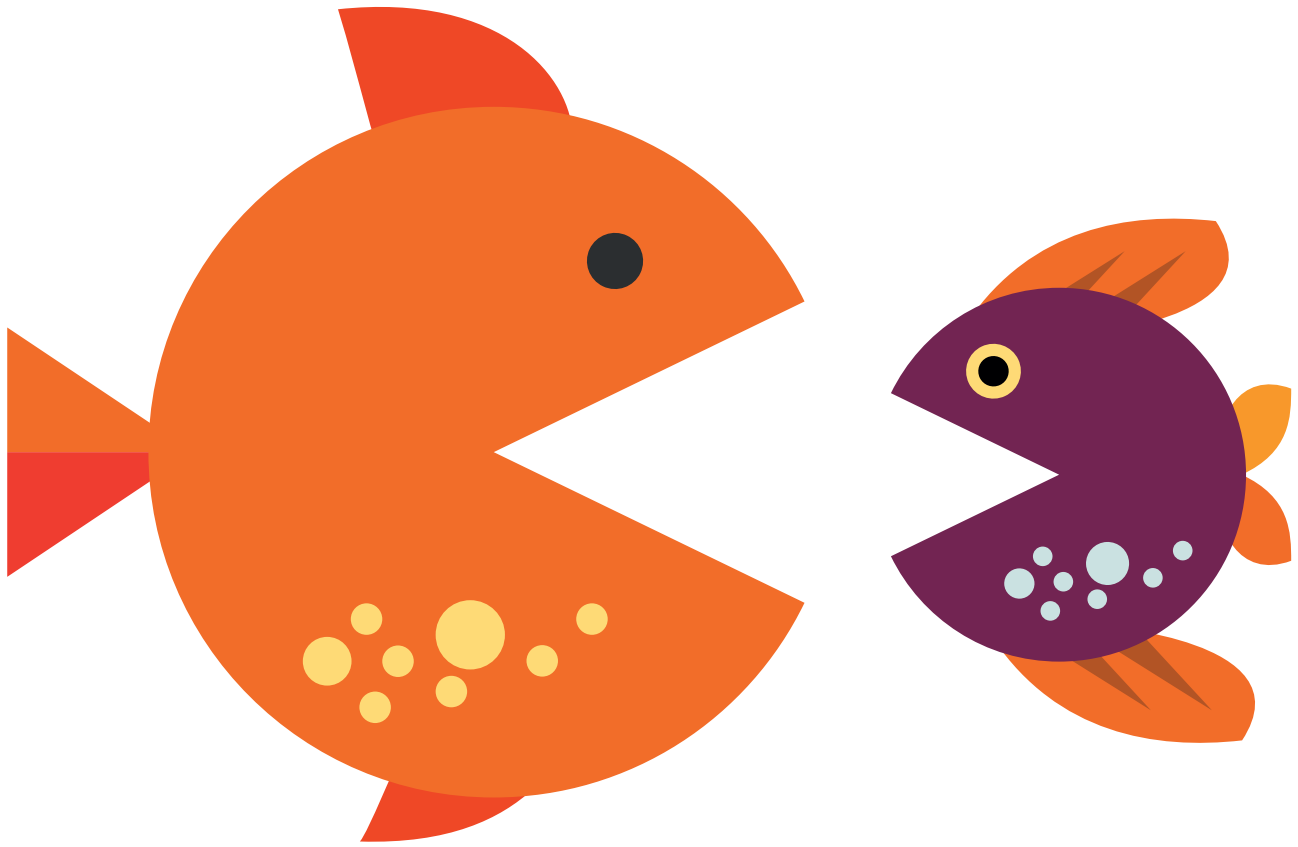
# FOOD SAFETY

Quincy Lissaur of not-for-profit organisation SSAFE explains why food safety should never be an after-thought in food business mergers and acquisitions.

Navneeta Kaul and Paula Hock look at recent technologies to extend food shelf life, without compromising on quality or flavour.



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## Playing it safe in mergers & acquisitions

Failure to anticipate the food safety risks that can arise when acquiring companies – especially less mature ones – has led to production stoppages, product downgrades, dramatically higher costs, and severe reputational damage. *Quincy Lissaur* of not-for-profit organisation SSAFE explains why food safety should never be an after-thought for anyone taking on a food business.



2017 WAS ANOTHER record year for global food and drink industry acquisitions. Transactions averaged almost 14 a week; 40 percent more than five years ago. In fact, apart from a dip in 2013, they've been increasing every year since 2012. As food companies try to keep up with rapid changing consumer tastes and demands, acquisitions have become a core part of growth and innovation strategies for many food businesses.

For some acquiring companies, however, a healthy appetite for consolidation and growth has resulted in a nasty dose of heartburn. Failure to anticipate the food safety risks that can arise, especially when buying less mature companies, has led to production stoppages, product downgrades, dramatically higher infrastructure and other costs, and severe reputational damage. Furthermore, as bigger brands continue to gobble up the smaller players now proliferating across the industry, these risks can increase significantly.

That's why SSAFE, a non-profit organisation founded to address the challenges faced by supplying and trading safe food around the world, worked with its members and Accenture to develop an Industry Best Practice Guide on how to manage food safety during the due diligence and post-merger integration (PMI) phases of M&A activities across the food industry. Available for free download from the SSAFE website ([www.ssafe-food.org](http://www.ssafe-food.org)), the guide is applicable to all types of food businesses, irrespective of geographic location or company size, and is flexible



to enable the user to tailor its application to its own unique acquisition situation. It also comes with a handy checklist for users to apply as they see fit to their M&A activities.

*"The intention of the SSAFE guide is to help the food industry improve how it conducts due diligence and post-merger integration activities. Applying the knowledge, experience and expertise from SSAFE members and Accenture can help businesses reduce potential food safety issues going forward."*

Neil Marshall, President of SSAFE

 **BELOW:** Overall process flow for food safety due diligence

 **FIGURE 1**

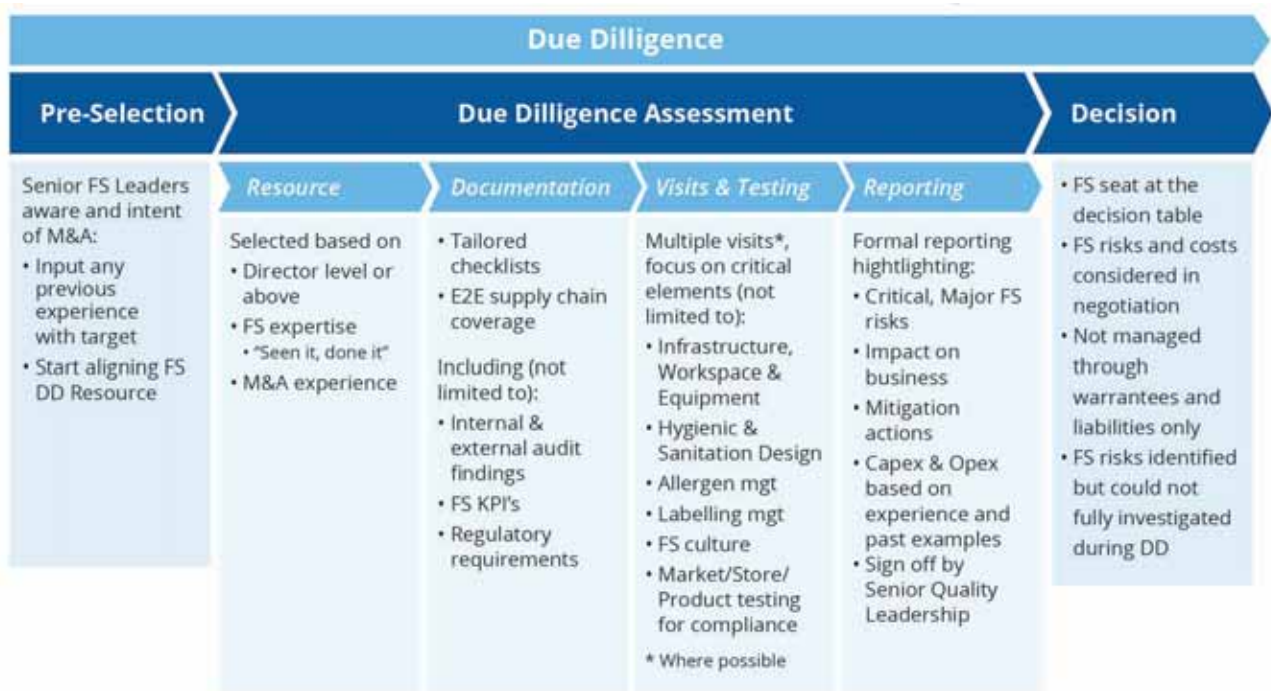
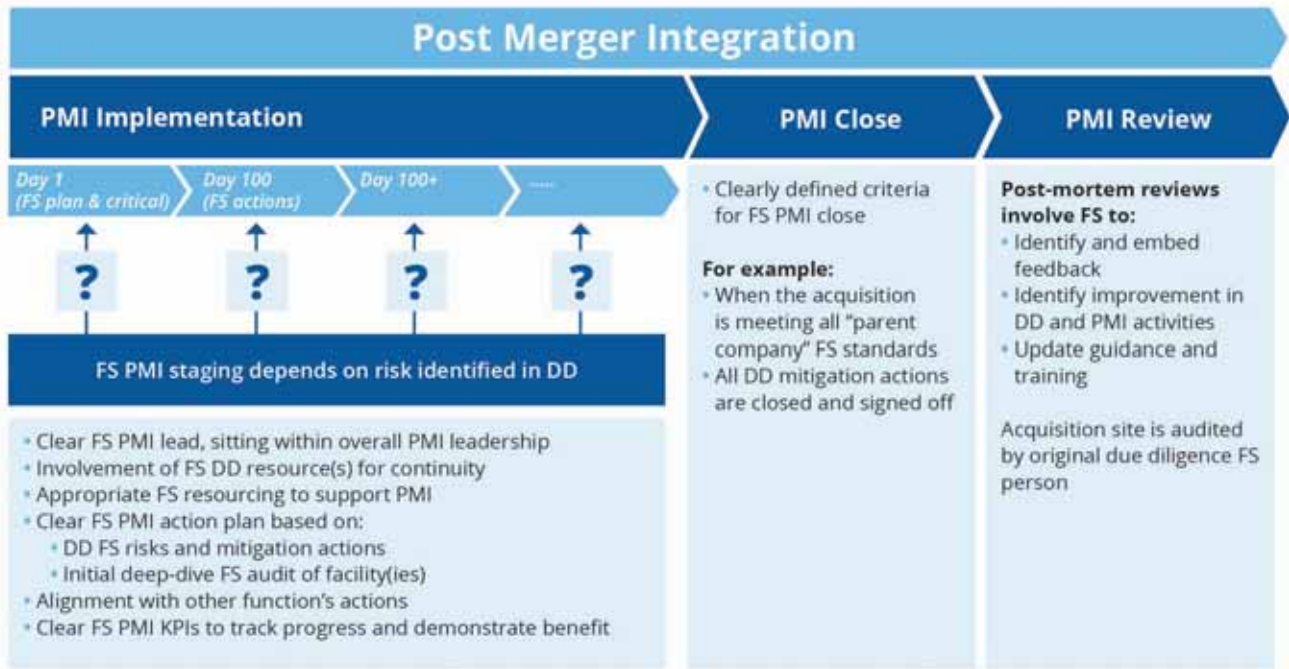


FIGURE 2



ABOVE: Overall process flow for food safety post-merger integration

ABOUT THE AUTHOR



**QUINCY LISSAUR** has been the Executive Director of SSAFE since 2013. Having graduated with a degree in entrepreneurship from Babson College in 1999, Quincy has worked as a management consultant throughout his career, which included eight years working on food safety and sustainability standards at the British Standards Institution. He is a Dutch national with extensive international experience, having lived in the Netherlands, Brazil, USA, Venezuela, the United Kingdom and France. He currently resides in Colombia.

The robust approach to food safety in both due diligence and post-merger integration activities set out in the guide is expected to help deliver significantly better outcomes. Since most food companies devote less than two percent of their due diligence efforts to food safety issues during M&A activities, as suggested by research conducted by our partner Accenture, it is vital that there is a consistent and common method for the industry to look at all aspects of food safety as part of a merger or acquisition. We believe this guide provides such a method.

**Due diligence**

When assessing a new acquisition, companies usually go through a three stage process:

pre-selection, due diligence assessment, and decision. The pre-selection phase is primarily a financial and commercial assessment to determine whether the target is attractive. The due diligence assessment is where, as part of a broader M&A team, a food safety expert should be involved to determine the maturity of food safety practices at the target company and how this may impact the purchase. The higher the risk of food safety failures identified during this phase, the bigger the potential financial impact could be after the acquisition is made. Finally, a decision is made based on all available information sourced. **Figure 1**, taken from the guide, shows a simple process flow of food safety due diligence activities.



The quality of a company's due diligence depends on the maturity of its due diligence activities. The more mature the company's food safety due diligence activities, the more likely it is that it will have a true and fair picture of the risks associated with the acquisition. The guide provides a maturity matrix to help companies determine how advanced they are in their food safety due diligence activities and provides guidance on how to strengthen and improve that maturity from a set of basic to a series of advanced activities. In addition, the guide lists eight key success factors to give the reader specific tips on how to improve their due diligence based on the knowledge and experience of our members.

### Post-merger integration

No M&A guide would be complete without looking at how to integrate the two companies' food safety activities if the acquisition is successful (Figure 2). Simply imposing the buying company's food safety systems and practices onto the acquired company is not an effective means of conducting the integration. Rather, it is important to develop a post-merger integration plan; set up a team with food safety experts from both companies; set key performance

“ The intention of the SSAFE guide is to help the food industry improve how it conducts due diligence and post-merger integration activities. Applying the knowledge, experience and expertise from SSAFE members and Accenture can help businesses reduce potential food safety issues going forward ” – Neil Marshall, President of SSAFE

indicators to address any risks identified during the due diligence; and close everything out over a predetermined period of time.

Although M&A activity may slow down somewhat over the next 18-24 months, as many food companies work on integrating recent acquisitions into their businesses, M&A will not go away. Ensuring that a company addresses food safety as part of its M&A activities is vital for continuous improvement, the strengthening of food safety, reducing recalls and outbreaks of foodborne illnesses, and ultimately ensuring the acquisitions made are a commercial success – both in the short and long term. It is the aim and desire of SSAFE that this guide will help deliver that. 📌



1. <https://www.zenithglobal.com/articles/2172>

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# Shelf life extended: far from an impossible dream

As consumers become more health-conscious and the demand for 'clean-label' ingredients continues to rise, the food industry is racing to come up with novel technologies to make food safe from spoilage for longer time frames without compromising the quality or flavour of that food.

*Paula Hock and Navneeta Kaul* look at recent developments.

spoilage. These methods include the incorporation of plant-based or food-based materials in packaging films, protective coatings and the use of antioxidant nanoparticles, among others, covered in a recent report by PreScouter.<sup>1</sup> **Figure 1** shows a summary infographic of the nine packaging technologies detailed in the report that utilise plant-based and novel derivatives to extend the shelf life of food and beverages.

## Plant-based antimicrobial packaging and coating solutions

Researchers at Nanopack,<sup>2</sup> an EU-funded three-year project, have utilised the antimicrobial property of plant-based essential oils to develop an antimicrobial packaging. The packaging involves the use of halloysite nanotubes (HNTs),<sup>3</sup> hollow clay mineral fibres made up of aluminum and silicon atoms, capable of being infused with essential oils. While HNT absorbs ethylene, the ripening hormone, the infused essential oils<sup>4</sup> act as antimicrobial agents to prevent the food from degradation. The researchers are currently testing the technical, industrial, and commercial viability of these smart antimicrobial surfaces for their application as an active food packaging solution. In a similar approach, scientists from the Bhabha Atomic Research Center (BARC), India, have utilised the antimicrobial and antioxidant activity of mango peels<sup>5</sup> for incorporation into bio-based packaging films. Both these packaging solutions are safe, durable, thermally-stable and even prevent water damage to food products. However, they are currently expensive to use, and would require research on more food items before widespread adoption.

## Novel additive-based packaging solutions

Sprouted potatoes have elevated levels  $\alpha$ -solanine, which is toxic to consume.<sup>6</sup> Scientists at the Chinese Academy of Sciences have devised a method to prevent sprouting in potatoes by using modified nanosilica<sup>7</sup> with amino silicone oil (ASO), to develop a hydrophobic nanosilica powder. Coating potatoes

**T**HE SHELF LIFE of food and drink is determined by numerous physical and chemical factors. For years, both consumers and manufacturers have been interested in finding ways to extend it. The most recent and innovative technologies under development within this field fall within three main sections:

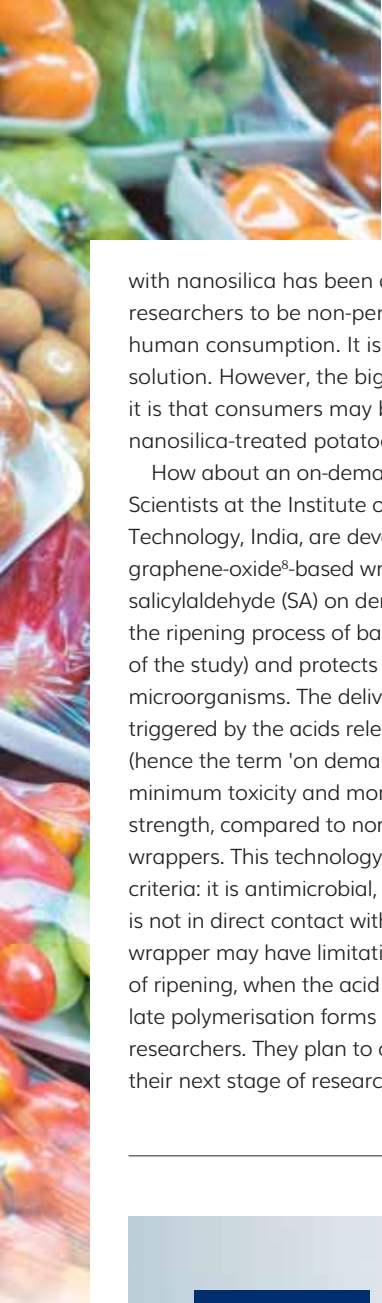
1. Novel packaging solutions
2. Next-generation additives
3. Food-treatment methods.

In each section, we discuss the main features of the different techniques covered, as well as the main benefits and challenges associated with each shelf life extension solution.

### 1. Novel packaging solutions

Companies and researchers are actively seeking out novel packaging solutions to slow food

**“** Researchers are currently testing the technical, industrial, and commercial viability of smart antimicrobial surfaces for the application as an active food packaging solution **”**



with nanosilica has been demonstrated by the researchers to be non-penetrating and safe for human consumption. It is also a cost-effective solution. However, the biggest bottleneck with it is that consumers may be hesitant to use nanosilica-treated potatoes, even though it is safe.

How about an on-demand packaging solution? Scientists at the Institute of Nano Science and Technology, India, are developing an inert graphene-oxide<sup>8</sup>-based wrapper that releases salicylaldehyde (SA) on demand. The release slows the ripening process of bananas (the target fruit of the study) and protects from spoilage-causing microorganisms. The delivery of the preservative is triggered by the acids released by ripening fruits (hence the term 'on demand') and possesses minimum toxicity and more flexibility and tensile strength, compared to normal cellulose-based wrappers. This technology meets three important criteria: it is antimicrobial, controls ripening and is not in direct contact with fruit. However, the wrapper may have limitations in the later stages of ripening, when the acid content reduces and the late polymerisation forms a lignin, as noted by the researchers. They plan to address this challenge in their next stage of research.

FIGURE 1



**Novel packaging solutions**

In another approach, some companies are using novel packaging solutions that eliminate the need for preservatives. Companies such as Advanta<sup>9</sup> are using alternatives to the standard modified atmosphere packaging (MAP) by ▶

**↑ ABOVE:** Shelf-life-extending packaging technologies utilising plant-based and novel derivatives

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RIGHT:  Next-generation additives

 FIGURE 2



“Coating potatoes with nanosilica has been demonstrated to be non-penetrating and safe for human consumption”

using a unique combination of a skin-pack aluminum poultry tray and a film that gets rid of oxygen, and contaminants that could spoil the food, allowing an increased shelf life of up to 300 percent. Similarly, StePac<sup>10</sup> in collaboration with Tadbik has generated a resealable lidding film, a next-generation MAP container that successfully preserved the freshness and flavour of cherries for more than 35 days. Researchers at the University of Zaragoza are developing a flexible, multilayer packaging with selenium nanoparticles (nanoSe)<sup>11</sup> as an antioxidant agent. The packaging could

help in absorbing antioxidants such as oxygen or free radicals to prevent food spoilage and demonstrated promising results with extending the shelf life of nuts, potato crisps, cooked ham, chicken and ready-to-eat vegetable mixtures.

These packaging solutions have generated a lot of interest, as Advanta's trays and StePac's lidding films are robust, thermally-stable, eco-friendly, automation-friendly, and preserve the quality of the food. And, packaging with nanoSe ensures superior antioxidant properties. Despite many advantages, they have limitations. First, Advanta's trays do not

EXPERT VIEW



**Kim Cushing**  
Product Marketing Manager,  
Solus One

*“An ideal method provides good, smooth throughput while providing capacity for volume fluctuations”*

## There's more to pathogen testing than just speed

**When you send your samples to a microbiology lab, will it make a difference to you which pathogen testing method the lab uses? Absolutely! Here's why...**

WHEN PATHOGEN screening, it can take from 24 hours to four days to obtain a result, depending on the technology employed. If you are holding stock in quarantine while waiting for a confirmed result, the speed of the screening will clearly have a significant impact.

But in addition to time to result, there are other less obvious features of the test that will impact on the lab's service level and speed of response.

Typically, microbiology labs are managing large but fluctuating volumes of samples daily. This can be difficult to manage when

volumes peak, potentially causing delays. Even when a lab is operating 24/7 there are still pinch points when many activities are happening simultaneously. An ideal method provides good, smooth throughput while providing capacity for volume fluctuations. Automated methods free up technician time to manage other essential laboratory tasks, helping to reduce bottle necks and enabling the lab to be more responsive.

Large volumes of samples also require large amounts of testing reagents. Methods that minimise the amount of cold storage space

required for reagents and reduce the volume of waste produced contribute to good organisation and efficiency. Also space is often at a premium in testing labs. Any method that minimises the amount of bench space occupied helps the lab organise workflow effectively.

In conclusion, labs using an automated, high-throughput, 24-hour pathogen test should be able to deliver the rapid and responsive service level that you require. Any lab using Solus One assays will benefit from all these features, which should be evident in the service provided to you. ■

insure against spoilage-causing microorganisms. Resealable lids need further optimisation, and packaging with nanoSe in the multilayer does not increase the barrier properties for secondary oxidation products such as aldehydes and hexanal.

## 2. Next-generation additives


Several ongoing research efforts are focused on modifying food and beverages for shelf-life extension by the addition of novel additives to the food itself. In their second report of their 'extending shelf life' series, PreScouter covered five next-generation additives,<sup>12</sup> summarised in **Figure 2**.

The additives detailed are safe and derived from plants, without additional development costs for the packaging processes. Because the additives are just an added component in the food, it results in the reduction of waste, making them environmentally-friendly, as an added benefit. The additives range from essential oils to herbs and components from plant waste that could be used alone or in combination with other natural substances for improved efficacy. With further development, these plant-based additives could potentially replace synthetic additives including EDTA.

**FIGURE 3**

Technology	Company / Organization	Phase	Thermal	Year
Cold Plasma	 IOWA STATE UNIVERSITY	Research	✗	2017/2018
UV Light-Emitting Diodes	 Agriculture and Agri-Food Canada	Prototype	✗	2018
Smart Spray Drying	 MONASH University	Prototype	✓	2018
Microchip Pulsed Electric Field		Research	✗	2018
eBeam Technology	 TETRA PAK	Prototype	✗	2017
Low-Temperature Drying	 University of Nottingham	Research	✓	2018
Thermosonication		Research	✓	2017

For example, Kemin<sup>13</sup> has successfully utilised extracts from rosemary, spearmint, and green tea for prolonging the shelf life of salad dressings and sauces past six months. The blend retains its chelating abilities like EDTA and is not affected by changes in pH. Another major player in the ▶

 **ABOVE:** New ways to prolong the shelf life of foods and beverages away from packaging and additive solutions

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ABOUT THE AUTHOR



**PAULA HOCK** is one of PreScouter's Project Architects. She heads the Transportation segment, which encompasses automotive and aerospace and defence projects. Paula works with research teams to provide clients with cutting-edge, actionable information to improve their businesses. This can mean problem solving, process optimisation, entering new markets, assessing intellectual property, and more. Paula earned her BS from DePaul University in Chicago before continuing on to her PhD in Physical Chemistry at the University of Pittsburgh. She continues to utilise her chemistry background and penchant for researching new areas in a variety of engagements with PreScouter's clients.

food industry, Kancor,<sup>14</sup> has developed a natural antioxidant solution from rosemary for the shelf-life extension of fat-rich foods by fighting lipid rancidity. Studies demonstrated that the solution outperformed tocopherol (another natural antioxidant), and TBHQ (a synthetic antioxidant) in food matrices.

Interestingly, some of these replacements make use of plant waste, which could further save the development cost for the production processes. Researchers at the Pontifical Bolivarian University have identified that cellulose nanofibrils<sup>15</sup> (CNF) derived from banana waste could make ice-creams less sensitive to changes in temperature and slow melting. The CNF-enriched ice creams are lower in calorie count and have improved texture and creaminess. Similarly, from grape waste,<sup>16</sup> scientists at the University of Nebraska-Lincoln have identified a way to extract the nutrients known as pomace, to enhance the shelf life of fatty foods. Recycling plant waste for extending shelf life offers an added benefit of reducing environmental wastage and bears economic profits. However, the current process of extracting, identifying and processing CNF and grape waste is labour intensive and further tests are underway to optimise the technology before widespread commercial applications.

**3. Food treatment solutions:**

In addition to the above mentioned methods, many research groups have focused on devising new ways to prolong the shelf life of foods and beverages away from packaging and additive solutions. This was the

topic of the third and final report<sup>17</sup> in PreScouter's *Extending Shelf Life* series. Some of the main trends covered are summarised in **Figure 3**.

These methods of food treatment do not require chemicals or additives to disinfect food and are effective at inactivating insects, spoilage-causing microbes and fungal spores for food preservation. Moreover, these methods do not generate waste, unlike packaging solutions. However, the commercialisation of most has been slow, and efforts are on for rapid industrial implementation.

Researchers at Murdoch University and Iowa State University have utilised cold plasma (CP),<sup>18</sup> which is a mixture of atoms, ions and excited molecules at any temperature between 25-450°C, to prevent fungal growth and preserve food quality. Though nascent in research, the technology offers a cost-effective solution, leaving no residue on the food. The biggest drawback, though, is that it can damage delicate foods. At Texas A&M University, researchers have devised a type of ionising radiation, called eBeam,<sup>19</sup> to irradiate fruits and vegetables and kill associated microbes. The technology aims to eliminate the application of toxic methyl-bromide as an antimicrobial agent for food products, with no effect on the quality.

In contrast to radiation, Monash University scientists are investigating the use of spray drying,<sup>20</sup> a technique used to rapidly heat a liquid or slurry with hot gas to turn it into powder, for extending the shelf life of milk and dairy products. However, the technique is still in its nascent stage of research

EXPERTVIEW



**Nina Spencer**  
Commercial Manager,  
Premier Analytical Services

*"Mycotoxins are thought to be the most important contaminants in the food chain and unacceptably high levels are a major reason for imports being rejected on entry into Europe"*

# Mycotoxins Update

**Mycotoxins are natural toxins produced when certain fungi infect agricultural crops during growth, drying and storage. They have become the focus of regulatory concerns throughout the world.**

THE ERGOT alkaloids are mycotoxins produced by several species of fungi in the genus *Clavicles*. Ergot poisoning in humans and domestic animals is known as ergotism. This disease may cause strange hallucinations, the feeling of itchy and burning skin, gangrene, loss of hands and feet, and even death. Maximum levels for ergot alkaloids are under discussion for the sum of ergometrine, ergosine, ergocornine, ergotamine, ergocristine, ergocryptine and their respective -inine forms. Initially, maximum levels are being discussed for cereal grains, cereal milling products and cereal based food for infants and young children ranging from 20 to 250µg/kg.

Alternaria toxins: the European Commission is considering

setting guidance levels and a recommendation to monitor levels of these mycotoxins. Foods considered for guidance levels are: processed tomato products, paprika powder, sunflower seeds and cereal-based foods for infants and young children.

**Mycotoxin low-down:**

- Mycotoxins occur at very low levels from parts per million down to parts per billion (µg/kg). Some toxins cause acute illness such as vomiting, but the major concern for developed countries is the long-term chronic effects – some of the mycotoxins may be associated with cancer in humans.
- Mycotoxins are thought to be the most important contaminants in

the food chain and unacceptably high levels are a major reason for imports being rejected on entry into Europe.

- Incidence and extent of mycotoxin contamination is primarily dependant on raw material, geographic and seasonal factors, as well as cultivation, harvesting, storage and transportation.
- Food processing cannot be relied on to remove mycotoxins.
- The elimination of mycotoxins from the food supply chain is not yet feasible.

Premier Analytical Services offers UKAS-accredited analysis for 37 different mycotoxins, including both Ergot Alkaloids and Alternaria toxins. ■



and requires optimisation to control pressure and temperature to prevent runaway reactions. In another exciting physical treatment, researchers are also investigating the use of microchip pulsed electric field<sup>21</sup> as an alternative to high-temperature short time (HTST) treatments for the sterilisation of fruit juices. This non-thermal food preservation technology destroys the microbial cell walls by high-voltage electric pulses – electrocuting the bad bugs! Again, the technology is in the early research phase and requires more testing before industrial application.

### Final thoughts

Consumers are continually pushing for longer shelf lives and better food quality for

the things they buy. "Food preservation is no longer a concern just for industry-related clients, but for consumers as well," comments Dr Paula Hock, PreScouter Project Architect who oversaw the reports. "The research in this area is especially interesting, as it's an industry that really listens to the consumer base," adds Dr Hock. The novel approaches discussed in this article provide the food and beverage industry with actionable insights and applicable knowledge. The industry is actively listening to its consumer base, and efforts are ongoing to satisfy the needs of the savvy and well-informed consumer. The time is ripe for innovations in the food industry to meet the challenge and deliver. 

### ABOUT THE AUTHOR



**NAVNEETA KAUL** is a member of PreScouter's global scholar network and is working as a scientist at KBI Biopharma in Boulder, Colorado. She holds a PhD in Biology from the University of Denver and also has a biotech engineering background. The focus of her research was to understand the mechanism of memory formation and how defects in it can cause the autism disorder known as Fragile X syndrome. She is passionate about communicating new technologies, research and business advances to a broader audience.

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# The safety and integrity of rice production




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THE SAFETY and integrity of rice production worldwide faces substantial challenges. Fraud in the rice supply has been well known for some time but the types of fraud and their scale appears to

be increasing dramatically. Reports of counterfeiting, 'toxic rice' and 'plastic rice' are now frequently reported in the media around the world. This has served to fuel substantial fears in many that

what they and their children are eating is not safe.

So how much truth is in these reports and what can be done to detect rice fraud at a global level? The webinar will outline

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# Monitoring and reporting mycotoxin contamination in cereal **foods** and raw **materials**

*Will Munro* from Food Standards Scotland and *Silvia Gratz* from The Rowett Institute present a review of a workshop held in 2018, which aimed to capture views from different stakeholders on the current state of mycotoxin monitoring in Scotland and beyond, and identify potential areas of concern.

**T**HE DISCUSSION at the mycotoxin workshop focused on *Fusarium* mycotoxins, which are the most relevant toxins in terms of UK primary agricultural production. Mycotoxins of interest include trichothecenes such as deoxynivalenol, nivalenol (type B trichothecenes), T2 and HT2 toxins (type A trichothecenes), as well as zearalenone.

In addition to *Fusarium* mycotoxins, ergot alkaloids were another group of compounds that were discussed extensively.

Dr Will Munro from Food Standards Scotland gave a brief overview of mycotoxins of concern and mycotoxin formation throughout the food chain. He then summarised the relevant EU regulations concerning mycotoxins in food and feed. ▶



**ABOVE:** Fungi *Fusarium* produces mycotoxins in cereal crops that affect humans and animals



Dr Silvia Gratz from the Rowett Institute gave an overview of her Scottish Government-funded research on plant-bound mycotoxin metabolites, so-called masked (or modified) mycotoxins. She described her mechanistic research using *in vitro* models to demonstrate that masked mycotoxins are not absorbed in the small intestine, but will contribute to human exposure following microbial hydrolysis and release of free parent mycotoxins by gut microbiota. She also presented findings on the presence of masked and free *Fusarium* mycotoxins (trichothecenes and zearalenone) in Scottish cereals from a collaborative project with SASA and SRUC. Furthermore, she presented pilot results on dietary exposure to T2 and HT2 toxins from the consumption of oat-based foods.

## ABOUT THE AUTHOR



**DR WILL MUNRO** is a Scientific Advisor at Food Standards Scotland and specialises in chemical radiological and environmental food safety. Dr Munro has 23 years of food safety experience and has a PhD in Radioecology from Imperial College London.

### Mycotoxins in UK oats

Derek Croucher from the British Oat and Barley Millers' Association (BOMBA) gave an excellent and detailed overview of T2 and HT2 toxins in oats, highlighting the issues for the industry deriving from milling and processing practices prevalent in the UK in comparison to EU. He showed, repeatedly over four years of data, that intake oat samples collected in Scotland were contaminated with higher levels of T2/HT2 compared to England. Furthermore, samples exceeding the indicative level of 1,000 µg/kg were found more frequently in Scotland. However, in his conclusion Derek stressed that all milled oat samples were consistently below the indicative level, which is also supported by an FSA retail survey. T2glucoside was only detected occasionally. He also highlighted the important health benefits of consuming oats. This presentation triggered an in-depth discussion on T2/HT2 Indicative Levels in cereals and the potential impact on the oat industry. Currently there is no rapid test for T2/HT2 - this makes testing at intake impossible and results would be received after the intake oats had been milled (and in some

cases consumed). This was, however, not considered a food safety concern given that in-mill blending occurs along with in-process mycotoxin reduction. This happens through cleaning and husk removal, which reduces the levels below the milled product Indicative Level. Intake cereal lots that exceed any future legislative levels must not be utilised in the food chain, but with no rapid test this will result in a massive disruption in the supply chain. With the TDI for T2/HT2 being lowered, potential consumer exceedance of the TDI may be more likely. Such tightening of standards is a major concern for the industry, which urged a proportionate approach balancing risk against the benefits of oat consumption.

### Field-to-store issues with cereal mycotoxins

Catherine Barrett from the Agricultural Industries Confederation (AIC) gave an introduction to ergot alkaloids and said that black grass, to date, is not a problem in Scotland but is very prevalent in England and spreading northwards. Grass ergot is a bigger problem in wheat and barley, whereas rye is more frequently contaminated with cereal ergot. In oats, cereal ergots were not detected, whereas grass ergot could be found. Ergot contamination is regulated in the industry, which employs colour sorters to remove ergot sclerotia from cereals. There are currently no rapid tests for ergot alkaloids that could be used by the industry. Rapid testing is routinely performed for DON and ZEN, but no rapid testing is available for modified forms. Public Analyst perspective and capabilities Jane White, from Glasgow Scientific Services (GSS), presented an interesting insight into the mycotoxin testing work of public analyst labs. She discussed issues of sampling, such as homogeneity of bulk samples and representative sampling of retail products, as well as the added complexity of providing reference samples for potential legal actions. She also discussed advantages of different mycotoxin detection methods comparing ELISA, HPLC and LC-MS/MS. T2/HT2 is frequently detected in oats, and a particular issue has been highlighted with oats grown in Scotland. Contamination varies greatly between years and intermittently much higher levels are detected, while organic agronomic techniques (such as long crop rotation) appear to lower T2/HT2 levels. The Indicative Level is set at 1,000 µg/kg for unprocessed oats, which in Recommendation 2013/165/EU refers to oats (with husk); the Contaminants Regulation (EC) 1881/2006 refers to unprocessed cereals however MLs have not been set yet. Cleaned and milled oat samples rarely, if ever, exceed these levels, while intake oats samples test positive more frequently. This is due to a blending effect during the milling process. T2/HT2 as well as their masked metabolites are also detectable in oat-based cereal foods but


at levels below the Indicative Level. Testing of masked T2/HT2 remains difficult, as no analytical reference standards are available. Although the Recitals to the Recommendation state that chronic human dietary exposure to the sum of T-2 and HT-2 toxins are not an immediate health concern; EFSA risk assessments have recently been revised, leading to a lowering of the TDI for T2+HT2 from 0.1 to 0.02 µg/kg bw. Analysis of a small dietary intervention study suggests exceedances of this new TDI may occur in high oat consumers. Further evidence needs to be gathered on human exposure, especially during years of high prevalence of T2+HT2 in agricultural crops. There was a need for a proportionate approach to regulating these toxins, taking into account both risks and benefits.

### Ergot alkaloids

An area of concern in recent years, both at the UK and EU level, ergot alkaloids are produced by cereal ergot or by grass ergot that infects black grass as a grassweed host. The presence of ergot sclerotia is a visible indicator for contamination and the number of sclerotia is correlated with the levels of ergot alkaloids. However, ergot alkaloids may be detected in apparently uninfected grain and little is known about the production of ergot alkaloids and their distribution within the cereal grain. It is

suspected that minimum/no till techniques result in higher ergot levels. Discussions are ongoing on setting ML for ergot alkaloids in cereal-based products, but the availability of the analytical methods and reference materials to test for these compounds is a continuous issue.

### Brexit and contaminant monitoring

Brexit and contaminant monitoring. The EU operates and funds an extensive testing and monitoring programme for contaminants in food and raw materials entering the common market through non-EU imports. This monitoring programme frequently detects high-level mycotoxin contamination in cereal and nut imports, which led to 418 border rejections in the 2016 annual RASFF report. Additionally, most imports enter through non-UK ports (eg, Rotterdam), where testing takes place and they then have free movement across the EU. Upon the UK leaving the EU, this free movement and testing capacity is highly likely to be lost and will need to be replaced by a tailor-made UK system to ensure the safety of incoming agricultural commodities. The current chemical contaminant testing capability in the UK (including mycotoxins) is already depleted, in part due to funding cuts, and discussion on this topic did not offer any insights into how this might be resolved. 

### ABOUT THE AUTHOR



**DR SILVIA GRATZ** is a Research Fellow at the Rowett Institute with expertise in human nutrition and food toxicology. She heads the mycotoxin research project and is funded by the Scottish Government RESAS Strategic Research Programme.

## Regulated, modified and emerging: the occurrence of mycotoxins in food

**Future anticipated changes to the world's climate are thought to increase our risk of exposure to mycotoxins, where the geographical prevalence and occurrence of traditional, modified and emerging toxins is expected to adapt with the changing environment. Controlling growing conditions and implementing relevant regulations alone cannot reduce the risk from mycotoxins.**

Mycotoxins are secondary fungal metabolites, which, according to the FAO, affect an estimated 25 per cent of the world's crop annually. Modified mycotoxins are formed by reactions during processing, by microorganisms or by the metabolism of plants. Climate and environment are key factors in the occurrence of mycotoxins, produced before or after harvest and during drying, processing and storage. Consumption of such contaminated food or feed can induce various chronic and acute effects on humans and animals, especially given the tendency of multiple mycotoxins in a single crop (co-occurrence).

To understand the occurrence of toxins and influence regulations setting toxicologically safe residue limits, analytical testing is essential. This is evident in recent years, where many food testing labs are embracing LC-MS/MS routinely, to develop efficient, multiresidue methods for the detection and quantitation of co-occurring toxins in a single run.<sup>1</sup> To understand the risk the more novel toxins pose, many labs have extended these methods to investigate a wider scope, such as ergot alkaloids, modified and emerging mycotoxins.<sup>1,2</sup> Furthermore, the adoption of high resolution mass spectrometry, including the addition of ion mobility,

is increasing, where accurate mass, fragmentation patterns and collisional cross section (CCS) values are allowing for the discovery and identification of novel mycotoxins.<sup>3</sup>

Understanding that changes to the global climate may impact the prevalence of such toxins, the role of LC-MS for the reliable detection, identification and quantitation is ever more important, while providing flexibility to expand the analytical scope, as future changes to regulations and climates may require. ■

[waters.com/naturaltoxins](http://waters.com/naturaltoxins)

References on request

### EXPERTVIEW



**Dr Simon Hird**  
Principal Scientist,  
Waters Corporation

*"Climate and environment are key factors in the occurrence of mycotoxins"*



# An Optimised Method for Measuring Acrylamide Levels

Acrylamide, although highly beneficial in certain industrial processes, is a well-known contaminant formed at high temperatures, during the production of starch containing foods, such as bread, coffee and potato-based goods. Acrylamide's toxicological properties have been extensively studied and so, among other concerns, it has been classified as a group 2A carcinogen by the International Agency for Research on Cancer (IARC).

ACRYLAMIDE hit the headlines of newspapers internationally in March 2018, when a judge in California, USA, ruled a warning of the risks posed by the compound should accompany all coffee products, as required under the State's Proposition 65. At a similar time, in April of 2018 the EU Regulation 2017/2158 was brought into force, establishing mitigation measures and benchmark levels for reducing the presence of acrylamide in food. This new legislation requires that food business operators wishing to trade in the EU put in place simple and practical steps to manage acrylamide within their food safety management systems.

Consequently we have developed a new method using LC-MS/MS to provide a rapid, cost-effective approach for quantifying acrylamide in processed food matrices including potato crisps, coffee, bread, and baby food.

## Experimental

Homogenised samples of retail coffee, potato chips (crisps), bread and baby-food products were prepared using a modified QuEChERS method with isotopically labelled internal standard (acrylamide d3). Single laboratory method validation was completed for the store purchased food products, along with reference materials of coffee and crisps (purchased from the FAPAS proficiency scheme). The performance of the method was assessed using the criteria in Commission Regulation (EU) 2017/2158.

## Results

In-house verification of this approach showed excellent sensitivity for the detection, identification, and quantification of acrylamide. The modified QuEChERS method provided effective extraction and cleanup of acrylamide, even for

difficult matrices such as crisps and coffee. This rapid cleanup method achieved excellent sensitivity and selectivity allowing for a reduction in the mass of laboratory sample taken for extraction, which in turn helps keep the contamination of the LC-MS/MS system to a manageable minimum.

The results from matrix reference standards demonstrate that the analytical methodology is accurate (recoveries within 86 to 107 %), reproducible (%RSD <6 %, n=6) and rugged. ■

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# FOOD GRADE LUBRICANTS & FOOD PROCESSING

Mayank Sharma offers an overview of the global food grade lubricant market, points out recent developments and highlights key factors that will impact its future growth.

The Basque Country is combining centuries of knowledge with the very latest technology to sustain its prized tuna fishing industry. Jenny Linford reports.



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# Business booming for the global **food grade** lubricants market

*Mayank Sharma* offers an overview of the global food grade lubricant market, points out recent developments and highlights key factors that will impact its future growth.

**F**OOD GRADE lubricants are used to minimise the wear and tear of industrial machinery caused by issues such as corrosion, friction, and oxidation. In some extreme cases these lubricants can also prevent or reduce electrical resistivity, while increasing thermal conductivity. They are widely used in the food & beverage industries, primarily because they don't present any physiological threat or affect the odour and taste of the finished products.

The global food grade lubricants market (Figure 1) is highly competitive. In 2018 it was valued at US\$239 million, with expectations to grow at a Compound Annual Growth Rate (CAGR) of 8.43 percent in the period 2018–2023, to reach US\$358.28 million. The increasing consumption of food products such as oilseed, meat, dairy, and beer will increase the use of food and beverage processing machinery to further drive growth.

According to the United States Department of Agriculture (USDA), food grade lubricants are divided into the following three categories:

- H1 lubricants are used in food processing units where there is a high possibility of direct contact with the food material. These lubricants are made of one or more base stocks, with additives, and thickeners as listed in the US FDA's regulations 21 CFR 178.3750. These lubricants are used in food and drink processing industries.
- H2 lubricants are used in equipment and machine parts where there is no possibility of the lubricant or lubricated surface coming into contact with the food material. These lubricants do not contain harmful materials such as antimony, cadmium, mercury, selenium, carcinogens, teratogens, mutagens, and mineral acids.
- H3 lubricants are used in trolleys, hooks, and similar equipment. These lubricants are soluble in edible oil and are generally used to clean and prevent the formation of rust.

Food grade lubricants can be categorised depending on their base ingredients as mineral or synthetic-based lubricants. Mineral oil lubricants are extracted from crude oil and consist mainly of hydrogen and carbon. They are the most widely used lubricants as they are more affordable and easily available than synthetic oils. Mineral-based food grade lubricants are highly refined, tasteless, colourless, odourless, and non-staining in nature. Synthetic lubricant oils, however, are set to experience a higher growth rate because of their availability and cost advantages over mineral-based lubricants. In 2018, mineral-based lubricants dominated the global market with a share of approximately 77 percent, but is expected to decline to approximately 75 percent by 2023. Synthetic lubricant oils are more efficient than their mineral-based counterparts under extreme pressure and temperature conditions as they can be adapted to a wide range of viscosities, resulting in higher oxidation stability. Synthetic oil lubricants increase the performance and sustainability of equipment and play a vital role in maintaining a low production cost throughout the equipment lifecycle.

### Market developments

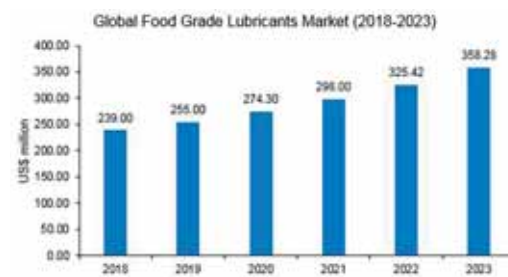
It's been a busy time for the sector. Recent product launches include the following:

- In September 2017, Klüber Lubrication launched Klüberfood NH1 74-401, a synthetic high-temperature grease that is effective at permanent temperatures up to 160°C. It also launched Klüberplus C2 for the lubrication of plastic conveyor belts. For instance, C2 K2 Ultra Dry is used to lubricate conveyor belts transporting carton beverage packages.
- CRC Industries continues to innovate throughout the sector, with its Perma-Lock system with Integrated Actuator designed to be "the most secure top on the market."
- In June 2016, Petro-Canada Lubricants launched Purity FG lubricants formulated with SynFX, which is an advanced additive technology.

Leading companies are focusing on launching effective products and entering into joint ventures or acquisitions to gain a competitive edge in the industry. For instance:

- In 2018, Fuch petrolub group acquired the lubricants business of Commercial Pacific, Chile

FIGURE 1



- In 2017, HollyFrontier Corporation acquired Petro-Canada Lubricants, which produces automotive, industrial and food grade lubricants and greases.

### Key markets

The Americas dominated the global food grade lubricants market in 2018, accounting for around 36 percent of the market, and it is expected to grow at a CAGR of some 8.7 percent during 2018–2023 to reach approximately US\$130 million. The implementation of food safety regulations in the US is expected to drive this demand for food grade lubricants.

The food grade lubricants market in APAC was valued at around US\$83 million in 2018 and is expected to grow at a CAGR of around 8.9 percent during 2018–2023 to reach around US\$127 million. The increasing demand for dairy products, packaged foods and meat products in countries such as China, India, and Australia is expected to be a significant driver of the market in APAC.

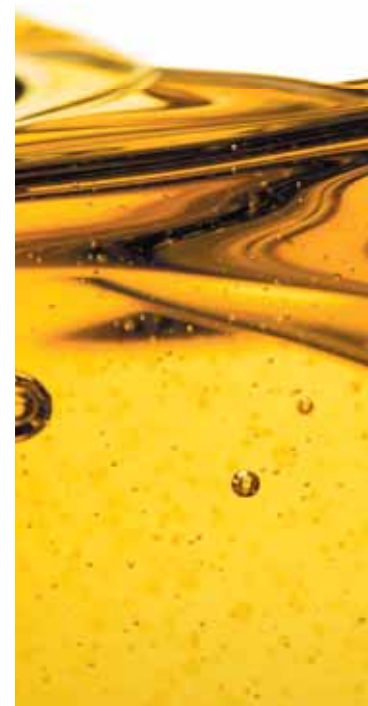
In EMEA, the food grade lubricants market accounted for around US\$71 million in 2018 and is expected to grow at a CAGR of around 7.5 percent during 2018–2023 to reach around US\$102 million. The growth of the market in this region is attributed to the growing incidents of food-borne infections such as those caused by EHEC (*Enterohemorrhagic Escherichia coli*) in countries like France and Germany. In Europe, organisations such as the EHEDG (a consortium of food industries, equipment manufacturers, research institutes, and public health authorities) have developed guidelines on the usage of food grade lubricants, which have been outlined in previous editions of *New Food*.

### Growth drivers

Major factors driving the growth of the food grade lubricants market are as follows:

- Stringent rules and regulations prohibiting the use of non-food grade lubricants due to growing concerns about health and safety in the food industry. For instance, in the US, the ingredients of food grade lubricants must be

LEFT: The current global market for food grade lubricants



### ABOUT THE AUTHOR



**MAYANK SHARMA** serves as an analyst at Infiniti Research Pvt Ltd. He holds an MBA degree in Business Analytics and Marketing from University of Hyderabad. He is from Shimla, Himachal Pradesh, India.

“The global canned food market was valued at around US\$98 billion in 2018 and is expected to grow at a CAGR of around 3.9 percent”

formulated in accordance with Title 21 Code of Federal Regulations (21CFR) 178.3570, which states the acceptable ingredients – such as oils, antioxidants, surfactants, etc – to be used in the manufacturing of food grade lubricants, along with use limitations.

- The demand for packaged and convenience foods is increasing in developing countries due to changing lifestyles, rapid urbanisation, and lack of time. This scenario is expected to have a positive effect on the food grade lubricants market, as the canned food market is the major user of these lubricants. The global canned food market was valued at around US\$98 billion in 2018 and is expected to grow at a CAGR of around 3.8 percent during 2018–2023 to reach around US\$118 billion.
- Food security is becoming a major global concern due to the ever-increasing population; the world population was 7.6 billion in 2017 and is expected to reach 8.6 billion by 2030. The demand for food will also increase, with a projected 16 percent increase in global meat consumption by 2025. The global demand for meat processing machinery is driven by growing food safety concerns and increased consumption of processed foods, including protein-rich meat products. The market is expected to grow at a CAGR of around 6.8 percent during 2018–2025; therefore, the demand for food grade


lubricants for machinery equipment used in meat processing is also expected to increase.

**Future challenges**

Some of the key issues that the food grade lubricants sector is likely to experience over the next few years include the following:

- The carbonated beverage industry is witnessing slow growth rate due to regular checks on manufacturers due to various contamination issues. The growing awareness of health risks associated with the consumption of carbonated drinks has shifted consumer preference to flavoured water, juices, and other healthy products.
- Consumers are reducing their consumption of processed meat, as research has suggested that excessive consumption may be a contributor to colorectal cancer.

**Some final reflections**

Not only do Food grade lubricants protect machine parts, they also prevent health hazards in case of incidental contact with food products. Despite all the advantages of food grade lubricants, lack of awareness hinders the adoption of food grade lubricants in certain developing regions. The message for any serious, reputable food company is clear, however: food grade lubricants are an essential part of best practice. 

EXPERTVIEW



**Tom Van de Velde**  
Marketing Manager,  
CRC Industries Europe

# The right lubricant for your food plant

When it comes to choosing lubricants for use in the food and beverages industry, quality, NSF classification and safety play a big part in the decision-making process.

**NSF classification**  
Any lubricant used in a food production zone will have to have an H1 classification. These lubricants are intended for use in applications where there may be the possibility of incidental food contact.

I always recommend using a product with unique NSF registration. Some brands offer products with dual NSF classification, e.g. H1 and K1. This means that the product has an H1 classification when used as a lubricant and a K1 classification when used as a cleaner. H1 products can be used in food production areas, K1 products only in non-processing areas. This dual classification means technicians can mistakenly think

that such a product can be used as a cleaner in a food production area, something that is not allowed as it is of course a threat to food safety.

**Risk of plastic contamination**  
Plastic contamination is a real risk nowadays because most production plants are equipped with metal-detecting scanners but have no detection systems for contaminants such as plastic. It is therefore vital that manufacturers can control the risk of plastic contamination. Plastic straws and caps of aerosols can easily get lost and fall into the production line.

To help food manufacturers in controlling this risk, CRC has

equipped all its H1 aerosols with the Perma-Lock actuator, a unique spray system that does not contain any detachable pieces, which might fall into the food line.

**Easy recognition of the H1 lubricant**  
You can have the best and safest lubricant on the market, but if it is not used where it is supposed to be used, it won't help you much. That's why CRC puts a green circle and the NSF-registration number on all its H1 lubricants. In addition, the green Perma-Lock actuator with its yellow straw is easily recognisable, making it a practical choice for operators looking to select the correct lubricant. ■

*"I always recommend using a product with unique NSF registration"*



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## Tuna fisheries: investing in a sustainable future

The Basque Country is combining centuries of knowledge with the very latest technology to sustain its prized fishing industry. *Jenny Linford* reports.

**A** SEA-GOING, boat-building people, the Basque community have long looked to the Cantabrian Sea as a valuable resource. Indeed, the first commercial whalers were the seventh- and eighth-century Basques and, to this day, commercial fishing for fish – including anchovies and tuna – forms an important part of the Spanish Basque Country economy in its coastal regions.

While traditional fishing methods – trolling (fishing with baited hooks) and pole and line fishing – are still used, a visit to the region reveals the extent to which, in the 21st century, science and technology are now playing their part in the local fishing industry. Central to this process is AZTI, a technology centre and research institute established in 1981 by the Basque Government and now run as a private foundation. Initially founded as a specialist in fisheries management, over the decades AZTI's work has expanded beyond this to encompass the world of food with its staff now numbering over

### ABOUT THE AUTHOR



**JENNY LINFORD** is a freelance food writer, based in London. She is the author of several books on food and cooking, including *The Missing Ingredient – an exploration of the role time plays in growing, making and cooking food* – to be published by Penguin paperback in March 2019.

240 people. 'Transforming science into business' is one of AZTI's straplines and its work for clients is wide-ranging, drawing on its staff's areas of expertise. In food research, for example, advertised areas of expertise on offer include state-of-the-art food preservation processes and technology, production efficiency, sensory analysis, new health food products development and trichloroanisole (TCA) analysis and atmospheric capture in wineries.

Given its origins, however, AZTI's knowledge of fisheries fundamentally underpins its work. "AZTI is orientated specifically to the sea and the health of the sea," explains AZTI's Scientific Director Xabier Irigoien. "We try and deal with the whole chain, starting with the environment and ending with the consumer. One of our catchphrases is 'from the ecosystem to the plate.'"

The issues of sustainability and traceability are important ones in the food supply chain and these are both areas in which AZTI does a lot of work, notably with regard to tuna fish.



**LEFT:** Manual de-heading machinery is used. CREDIT: Serrats. Artisanal Elaboration of White Tuna (Albacore) Preserves.

In order to try to sustainably manage tuna populations around the world, quotas are set for various tuna fisheries, explains AZTI's Head of Research Josu Santiago, who has been at AZTI since it was first established and possesses considerable experience in this field. Setting these quotas is far from straightforward. They require negotiating agreement among interested parties through international organisations, such as the International Commission for the Conservation of Atlantic Tuna (ICCAT), to which AZTI sends its scientists (including Santiago) to contribute their advice and data to working committees. "Ten to fifteen years ago, science didn't matter in the decision-making process," says Santiago. He cites an example from 2006 where the scientific advice to restrict the catch of Atlantic and Mediterranean tuna to 15,000 tonnes was ignored, with ICCAT instead setting double that amount as its quota. "Fortunately, now that has changed; they do listen to scientific advice."

AZTI has also developed technology specifically to be used by the fishing industry in a number of ways. An example that Irigoien gives is the development of FLBEIA Software, a simulation toolbox. "This allows fisheries to simulate management strategies and to see – before these are actually implemented – what the impacts for the fish population, the fishery and the business side would be," explains Irigoien. "We developed it 25 years ago and demand for it is increasing."

Another modelling tool developed by AZTI is Bonicho, designed to help the fishermen choose where to go to find albacore tuna. "We use oceanographic models and satellite information to suggest where the fish are likely to be. It's aimed at reducing costs for the fishermen. They have quotas so they can't catch more, but if you reduce the travel they spend searching for the fish, then you reduce their costs and improve their profits," Irigoien continues.

Traceability and preventing food fraud are other areas where AZTI has particular expertise. "Here in the Basque Country, for example, albacore is the tuna we prefer, so it's very tempting for the unscrupulous to put other, cheaper species in the can and pass it off as albacore," observes Irigoien. In response, AZTI uses DNA testing to verify the species of fish and ensure that any fraud is halted in its tracks. Genetic PCR-sequencing allows for unequivocal species identification, not only on fresh and frozen fish, but also on processed products. Parties interested in using these tests range from organisations working to promote a good marine environment to the canning industry and food brands. The benefits for companies include authentication, obtaining quality standards that consumers expect and demand, and product differentiation. AZTI is also a lead partner with TellSpec, a UK-headquartered company, working on developing a food spectrometer with the aim of determining farmed fish from wild fish in order to help tackle food fraud in this area.

Given their work promoting sustainability in tuna fisheries, the fact that the local albacore fishery in the Bay of Biscay (where the fishermen use pole and line and so catch very little bycatch in the process) has been certified as sustainable by the Marine Stewardship Council (MSC) is a source of satisfaction to AZTI. "We have a very good relationship with the local fleet, developed over years," says Irigoien, "there is a lot of trust now. They understand that we can help them with management, with technology. We meet with them several times a year, (and) ask them what their problems are." Looking to the future, he explains that the institute is doing a lot of work "trying to improve management and efficiency". One way which he considers offers scope to achieve these goals is through using international satellite tracking for vessels; "if you can reduce the travel time that makes for increased profitability." ▶

**“ Ten to fifteen years ago, science didn't matter in the decision-making process. Fortunately that has now changed, they do listen to scientific advice ”**



**ABOVE:** Quality control is a key part of the preserving process. CREDIT: Serrats. Artisanal Elaboration of White Tuna (Albacore) Preserves.



May 2018 saw the launch of another AZTI idea – Bermeo Tuna World Capital (BTWC). BTWC is a public-private alliance, which works to promote the sustainable management of tuna by sharing knowledge and good practice internationally. The association brings together key players in the tuna value chain in the port of Bermeo, the Basque Country and around the world, including public institutions, such as the Basque Government, AZTI itself, Freezer Tuna Seiner Associations (ANABAC AND OPAGAC) and several canneries. Given the pressures on tuna stocks around the world and the expected increase in world per capita fish consumption, the goal of sustainably managing tuna populations is one that all parties in BTWC feel is important. Bermeo, after which the association is named, is a major Basque Country fishing port; a place that encapsulates the importance of tuna fishing to the local economy. The Bermeo fleet comprises 50 freezer tuna seiners and 25 coastal vessels; the fleet's catch comprises 10 percent of the world's tropical tuna catch, generating 1.250 billion euros in the tuna value chain.

Today, the town of Bermeo is a canned food hub, served by the port, which supplies seasonally available fresh fish and contains useful industry resources such as refrigeration and freezer

**BELOW:** Acoustic technology is used to improve the prediction of the distribution of schools of tunas. CREDIT: AZTI



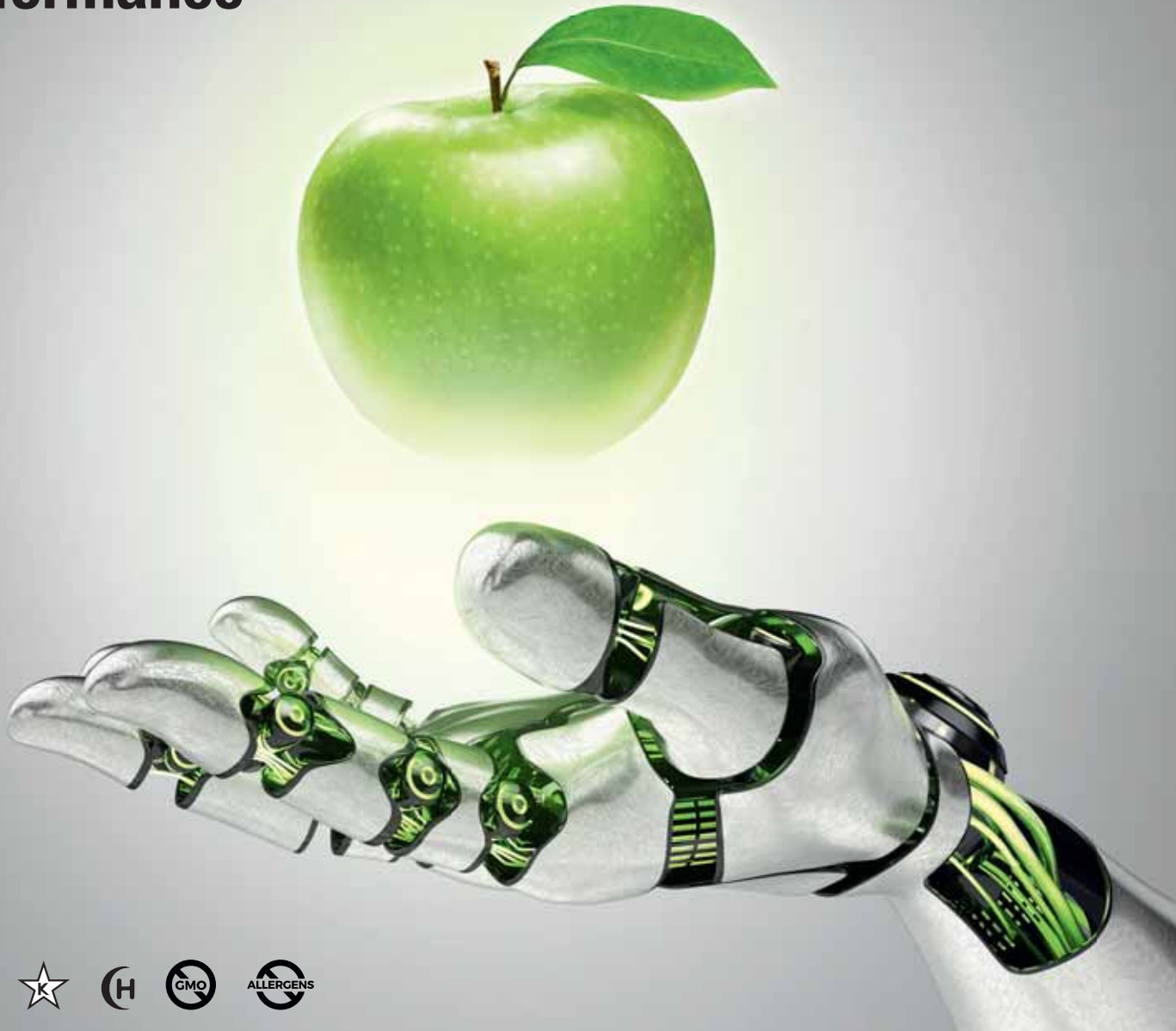
companies. Among Bermeo's fish canning businesses is Serrats, a family-run, fish canning business founded in the town in 1890 by Jose Serrats, who migrated from Catalonia to the Basque Country lured by the potential of working with the plentiful fish stocks found in the Cantabrian Sea. In a competitive canned fish market, Serrats' emphasis is on the quality of its products and the artisanal aspect of its processing. The factory produces a million kilograms of tuna per year; "The biggest cannery can do in one week what I do in a year," acknowledges Ignacio Serrats, the company's Director, with a smile. Eighty percent of the fish it processes is caught in the Cantabrian Sea. A tour of the factory to see the process up-close reveals the hard work and skill involved. Much of the work preparing, cutting and trimming the tuna is carried out in the traditional way; that is, by hand using a local workforce whose deftness reveals their experience. Freshly caught albacore tuna – each fish between 9-15kg – arrive at the factory (from the docks) where they are sorted by size and have their heads and guts removed by hand. The fish are cooked for three hours at a temperature of 98°C, cleaned and cooled. During the next stage, the fish is divided into pieces, cleaned again, placed in cans and jars, covered with olive oil, sealed and sterilised. The premium, fragile tuna cuts – namely the ventresca (the fatty tuna belly prized for its delicate texture) and cogote (the neck), which are sold separately at a high price – are cut out by hand and treated with care during the entire preserving process.

While proud of its heritage, Serrats has always been a forward-looking business. It was the first local company to begin exporting canned fish to the United States in 1914 and the first cannery to introduce the use of glass jars for its bonito del norte. New technology plays its part in the factory, with the company having invested in an X-ray detector as well as a metal detector to check the contents of the cans and jars. Ignacio Serrats was a key player in the move to have the albacore fishery certified by the MSC, feeling strongly that this is an important, long-term matter for the local industry. Serrats as a company is appreciative of the knowledge and skills offered by AZTI and proud to be a member of BTWC. "The association was created to boost Bermeo and the surrounding region as a standard bearer of sustainability; something we at Serrats are firmly committed to," explains the company's Export Manager Sara Asensi. "Its creation allows us to have a great chance to learn and keep learning, whether it's in terms of new technologies, or through relationships or other opportunities." She and her colleagues are optimistic that the association will bring economic opportunities: "On a business level, the fact that Bermeo's name will be even better-known and recognised will help us in selling the products we make here." 





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# Application of NMR as a solution for detecting honey fraud

At QSI, NMR honey profiling is used routinely to detect honey adulteration, particularly the addition of sugar syrups – the most widespread form of honey fraud. Declared botanical variety and geographical origin can also be verified with this technique.

IN THIS webinar, Gudrun Beckh (CEO at QSI) will discuss how NMR is applied in routine analysis and the advantages it has to offer over other techniques. Traditional testing methods often struggle to detect new and sophisticated sugar syrups that have been designed to pass adulteration tests. With NMR profiling, a fingerprint of the sample is acquired, and many parameters are analysed simultaneously. The approaches applied for syrup detection and for verification of origin will be explained.

## What to expect


The simple sample preparation and fast measurement that NMR offers will be described, as well as the wide range of information from the multiple parameters that can be acquired simultaneously. Bruker BioSpin Market Manager for Food, Feed and Beverage, Thomas Spengler, will introduce the NMR Food Screener used at QSI and the robust background reference database will be discussed.



## Key topics

- How NMR works and is applied as a tool for routine, daily analysis of honey
- The use of NMR spectral data to determine sugar adulteration without the need for confirmation by techniques
- The use of NMR for verification of the declared geographical and botanical varieties
- The advantages the methodology has to offer over conventional methods
- The background reference database that ensures complete reliability
- How NMR is a powerful method for combating the dynamic nature of food fraud.

## Who should attend?

The webinar will appeal to food testers, honey packers, importers or exporters, people working in regulatory or governmental bodies and those ensuring food authenticity and safety in the food industry. It will also be of interest to beekeepers, NMR specialists, and people working in the cosmetics industry. 



27 FEBRUARY 2019



16.00 (GMT)

## KEYNOTE SPEAKERS:

### THOMAS SPENGLER

Sr. Market Manager, Food, Feed and Beverage Markets, AIC Division, Bruker BioSpin

### GUDRUN BECKH

CEO of Quality Services International

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## Forging a **future** for agribusinesses in the **UK**

With the current uncertainty over Brexit, how have other nations handled comparable situations? *Jessica Calderón* looks at what agri-food companies in the UK might be able to learn from Mexico's experience in the wake of the US threat to abandon the North American Free Trade Agreement.

**“Changes and innovations that are being implemented by Mexican agribusiness companies to avoid future losses should the US abandon NAFTA can be looked at in the context of the UK withdrawing from the EU”**

**H**OW CAN agri-food companies in the UK tackle some of the challenges and opportunities associated with Brexit? To make founded suggestions a similar political situation was analysed: that of Mexico with Canada and the United States (US) regarding the possible withdrawal of the US from the North American Free Trade Agreement (NAFTA). Obviously, anticipating the outcome of the US exit from NAFTA and that of Brexit is based purely on speculation, and circumstances could have changed dramatically since time of writing. However, the comparisons are worth making, given that they are two politically similar situations.

Mexico's economy is highly dependent on agriculture, with the sector in turn depending on NAFTA. However, it relies heavily on the US, as its neighbour, as its main trading partner. Given this, the changes and innovations that are being implemented by Mexican agribusiness companies to avoid future losses should the US abandon NAFTA can be looked at in the context of the UK withdrawing from the EU.

### **Possible UK-EU27 trade agreement**

My research analysed the pros and cons of creating new Free Trade Agreements (FTA) with countries outside the EU27 after Brexit. The UK has the potential to become an attractive economic hub if it manages to secure an FTA simultaneously with the EU and countries that do not have FTAs with the EU, eg, the US and China. Mexico could serve as an example, because it is both within NAFTA and has an FTA with the EU. It thus attracts foreign companies wanting to take advantage of tariff-free exports to the US and EU and its Foreign Direct Investment (FDI) is boosted.

### **Rules of origin (RoO) after Brexit**

If the UK negotiates an FTA with the EU27, it is anticipated that a zero percent tariff will apply for agri-food products. However, this will depend on whether British agri-food exporting companies comply with the requirements of origin, meaning that their products are considered British. The complication is that British companies have developed international supply chains. If British agri-food companies produce goods with different

**TABLE 1** Calculation of RoO for agri-food products – four scenarios that could establish the origin of a product

Classification	How to calculate it	Sample case
Content totally national	Normally, animals, fruits and vegetables are 100 percent original if they have been bred and obtained in the country of origin.	A carrot that is produced and harvested in the UK.
Enough modification	In this scenario, it is possible to use goods from any country. But the origin of the product is established by the extent to which it is modified in the country, where it is assembled or manufactured.	A blackcurrant jam produced in the UK where the fruit and sugar come from outside the UK. The transformation of lemon juice, blackcurrant and sugar into a jam is enough to be considered as originating from the UK.
Enough national content in weight	In this scenario, it is possible to use imported goods, if they are below the weight or volume set by the RoO laws to be considered as originating in the UK.	A berry granola that is made in the UK and that contains imported blueberries and raspberries. To be classified as originating in the UK the imported content must be below the limits established in weight by the RoO.
Enough value added	In this scenario, it is possible to use imported goods if the total cost is below the ratio limits set by the RoO laws to be considered as originating in the UK.	A passion fruit ginger beer, that is made in the UK with imported passion fruit, ginger, lemon and sugar. To be considered as originating from the UK the total cost of the imported content must be less than the percentage established by the RoO of the total cost of the final product. Where automation and the services count as part of the final cost.

origins, the product may no longer be considered British due to foreign components no longer complying with the Region of Origin (RoO) laws within a UK-EU27 FTA. The difference between a preferential and non-preferential rate is likely to be considerable, which could involve complicated and costly restructuring of supplier selection to establish new supply chains that qualify as 'national' under the FTA. NAFTA's RoOs illustrate how British agri-food companies might be able to negotiate a preferential tariff with imported goods, as it imposes a 0.2 percent tariff for agricultural products. Four scenarios that could establish the origin of a product are shown in **Table 1**.

For my investigation, a large Mexican agri-food company that exports to the US was interviewed. The company explained that there is currently an "unfair market" for foreign suppliers since purchase pricing is set by the US Food and Drug Administration (FDA) to protect domestic production. Also, their import specifications demand high labour standards, raising production costs. Accordingly, the company anticipates significant labour shortages and market fluctuations. The company also indicated that, if the most favoured nation (MFN) tariffs and World Trade Organization (WTO) rules were applied, should the US leave NAFTA it would only be convenient to export in seasons where US harvests are low, because this is when Mexican fruit is profitable. In this scenario, the company would protect itself against the increase in tariffs only to export to the US in the seasons where supply decreases, but the demand remains stable. The company also plans to add value, and thereby increase profit, by freeze-drying the fruit to give it a lifecycle of two years.

### Labour challenges

The Mexican company is planning to introduce strawberry-slicing machines. Though the initial investment in automation will be high, and the

sowing process would have to be adapted; the cost would be recovered in a couple of years owing to the decrease in wage costs. Still, if automation could help overcome the labour challenges, what would happen to all the unemployed people? Laws, fiscal policies and reforms must be inclusive to prepare citizens for future risks to unemployment, to ensure that everyone can benefit from automation instead of promoting unemployment.

### Other markets

The company has sought other markets offering long-term, fixed-price contracts and where Mexican fruits are valued – Dubai and Japan are examples. Although the quality controls for these countries are higher, having fixed prices for six months or more gives them the opportunity to organise and control their utilities. To solve the logistics and transportation costs, the company decided to establish Incoterm Free Carrier (FCA), whereby the seller leaves the goods at a location agreed by both parties, after which point the buyer pays the remaining logistics costs. In addition, the Mexican company decided to team up with other agricultural companies to share logistics costs by consolidating the export merchandise.

### Recommendations

British agribusiness companies could follow similar strategies to those followed by the Mexican companies. They could also take the opportunity to sell to countries outside the EU27, creating the possibility for new FTAs and making the UK more of an economic hub. British agribusinesses could thus use the opportunity to become exporting companies, using NAFTA as an example and investigating how FTAs, Incoterms and RoOs work. It is also important for British companies to understand how to get preferential tariffs of origin with international supply chains, adding value to a product via automation or innovation. 

### ABOUT THE AUTHOR



**JESSICA CALDERÓN** has an MSc in Logistics and Supply Chain from Sheffield University. As well as within the UK, she has studied, fully funded, in Mexico, Spain, Slovenia and Greece.

**“ The UK has the potential to become an attractive economic hub if it manages to secure an FTA simultaneously with the EU and countries that do not have FTAs with the EU – such as the US and China, for example ”**



# Lipid and fatty acid analysis using **state-of-the-art** gas chromatography

The characterisation of lipids is one of the major applications of gas chromatography (GC) in food analysis. In general, GC can be applied to the analysis of intact lipids, such as triglycerides, or to the analysis of the fatty acid composition based on fatty acid methyl ester (FAME) profiling.

A BROAD RANGE of columns and stationary phases are available for FAME analysis, and in his lively and enlightening presentation on 15 January, supported by Agilent, Frank David Ph.D, R&D Director, Research Institute for Chromatography (R.I.C), explored some of them. As he explained while taking us through the GC column selection process, different column technologies can be applied. A trade-off can be made between sample throughput and resolution, depending on the complexity of the sample involved. State-of-the-art GC equipment enables lab productivity to be substantially increased, ensuring optimisation of heating, cooling and column exchange cycles. Moreover in addition to analysis of fatty acid composition, intact lipids, such as triglycerides and wax esters can also be carried out by GC. For this, high-temperature GC conditions and dedicated

GC columns are required. Frank David also gave examples of carbon number separation and detailed analysis of triglycerides using more polar, thermally stable columns. He also spoke about sample preparation and answered a broad range of questions. Here's just a sample:


## How often does the Intuvo Guard Chip need to be replaced?

Clean samples mean fewer potential issues with contamination, so it's a question of replacing whenever you replace your column. The Guard Chip can be used longer than the liner.

## Can chromatograms be done with MS or do they have to be done with FID?

Yes, but if you want to quantify MS, it's a bit more complicated. You need to calibrate the system for every compound, because the response factors will be different. Options are available that enable you to have both FID and MS, but FID is the most straightforward option for quantification.

## What instrumentation is recommended for methylation?

For automated sample preparation, several systems are available. Depending on sample type and methods that are applied, a proper selection can be made. Miniaturisation depends on homogeneity of samples, minimum sample intake and required sensitivity. 



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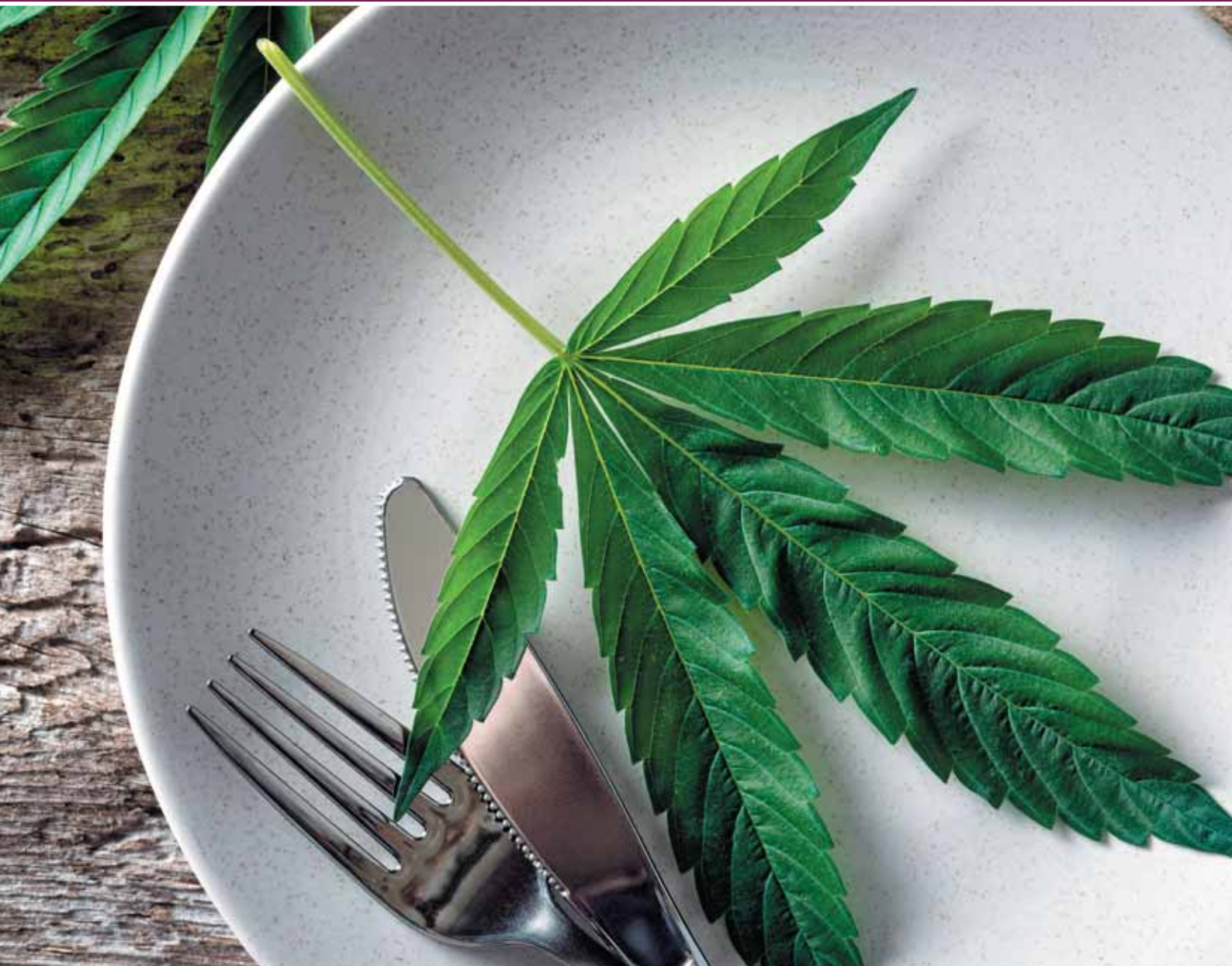
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# INGREDIENTS

Paul Bremner asks if there is more that companies could be doing to be primed and positioned to benefit from the opportunity that cannabis legalisation affords.

Hanne Christine Bertram and colleagues from the Department of Food Science, Aarhus University, Denmark, look at recent innovations in the meat-product sector.





## Cannabis-related patent filings in the f&b market – who's **ahead** of the **game**?

*Paul Bremner* asks if there is more that food and beverage companies could be doing to ensure they benefit from opportunities in this fast-growing market.

**C**ANADA'S LEGALISATION of marijuana, which came into force in October 2018, has attracted broad interest from the food and drinks industry. On one side there is interest from the marijuana and alcohol industries, converging into a one-stop shop for recreation with tetrahydrocannabinol (THC)-infused drinks, ranging from beers and spirits to sparkling waters. On the other side there is interest from the wider food and beverage industry, as these all look to benefit from the larger wellness trend by infusing cannabidiol (CBD) into foods and beverages.

Our recent report, *Cannabis Compounds in Edibles and Beverages*,<sup>1</sup> analysed published patent applications in the cannabis food and drink and cannabis-infused edibles areas, and has found that large food and beverage companies are potentially falling behind in innovation.

In emerging markets such as cannabis edibles and beverages, it is often useful to understand the competitive landscape from a market and IP (income protection) viewpoint. Patent data can reveal what products and techniques companies are actually working on. The failure to thoroughly map the patent landscape at an early stage in the R&D process can lead to problems with product development, branding and marketing expenditures.

### **Food and beverage companies lack patent coverage**

Patenting activity for cannabis food and drink has seen a large global increase in the past five years, as early protection of intellectual property rights

is critical to secure a competitive advantage in the marketplace.

Patenting activity for cannabis food and drink has seen a large global increase in the last five years (**Figure 1**). Two hundred and forty two simple patent families were filed in 2015, up from only 144 simple patent families filed in 2012. Yet none of the top 10 companies filing in this area include any of the larger food and beverage companies that might have been expected. Names missing from the list include PepsiCo, Nestle, General Mills and Kellogg's. This is odd, given that legalisation of cannabis represents a once-in-a-generation opportunity for these companies to position themselves as leaders in the new market. The legal cannabis market experienced a 31 percent growth in 2017, reaching \$8.5 billion, and will ultimately reach \$23.4 billion in 2022, according to the marijuana investment and research firm ArcView Group.

Despite the relative lack of patenting activity by these larger food and beverage companies, many have announced their intentions to join the growing market:

- Coca-Cola is in talks with Canada's Aurora Cannabis Inc to develop drinks infused with cannabidiol (CBD)
- Heineken's craft beer brand Lagunitas has launched Hi-Fi Hops, a beer-flavoured sparkling water with THC and CBD
- Diageo, maker of Guinness beer, is holding discussions with at least three Canadian cannabis producers about a possible deal

“Patenting activity for food and drink has seen a large global increase in the past five years”



- Constellation Brands Inc. announced it is spending \$3.8 billion to increase its stake in Canopy Growth Corp., the biggest deal in the burgeoning marijuana industry to date.
- Molson Coors Brewing Co. is starting a joint venture with Hydrotherapy Corp. to develop cannabis drinks in Canada.

As **Figure 1** shows, despite the overall increase in patenting activity, there remains a relative lack of patenting activity in this area – possibly due to the illegality of cannabis disincentivising R&D and subsequent legal protections.

State-by-state legislation in the US may also cause some larger incumbents to hold off from entering the market. PepsiCo has stated that the company would ‘turn over every stone to look for growth’,<sup>2</sup> and that it ‘will look at it very critically’, but noted that cannabis is still illegal under federal law throughout the United States. This illegality at the federal level means that, in interstate commerce, it is not legal to sell food to which THC or CBD has been added.

### Patent landscape analysis highlights market adjacencies

Landscape analysis of this area serves to highlight this relative lack of patents directly relating to food and drink (**Figure 2**). However, this landscape analysis does serve to highlight adjacent application areas that are relevant to the cannabis food and drink technology area. Combining patent landscape analysis with an applicant analysis provides insight into who food and beverage companies should perhaps be working and partnering with when looking to enter this area.

Patent landscaping is a 3D, topographical representation of the patents within a technology space, providing a 360° view of any area of interest. The peaks indicate areas with a high

patent count, while valleys and ‘white spaces’ represent areas with minimal patent filings and unexplored frontiers. These landscapes give a good idea of the make-up of the cannabis food and drinks technology area, as well as where each company’s speciality within this field lays (**Figure 3**). The 10 companies most actively patenting in this technology area were found to include a mixture of chemical companies such as BASF and Arkema, and fragrance and flavouring companies such as Firmenich and Givaudan.

Looking at this published patent data suggests potential for the major food and beverage companies to be partnering with these companies should they choose to enter this market. A well-designed patent strategy can enable companies to anticipate market and technology shifts, outflank competitors, and reduce competitive risks.

The current patent landscape analysis is hinting at the potential for major food and beverage companies to partner with chemical, fragrance and flavouring companies. This might help them confidently acquire the methods, techniques and processes required for effective product development and market entry.

Early protection of intellectual property rights is a critical component in any business’ efforts to secure a competitive advantage in the marketplace. However, the combination of a once-in-a-generation opportunity and the necessity of early protection of intellectual property rights, means some companies may still be reticent. Confidence may be lacking until full US federal legalisation occurs.

While the US PTO does grant cannabis-related patents despite the drug still being classified as a Schedule I drug, this federal illegality of marijuana means the industry lacks clarity over how intellectual property rights would hold up if challenged in a US federal court. ▶

### ABOUT THE AUTHOR



**PAUL BREMNER** is a research analyst at PatSnap focused on innovation trends across industries and is an advocate for business intelligence via patent analysis. Paul is an experienced analyst with more than six years’ experience producing patent analysis reports, market reports and custom research and consultancy for a broad range of clients.

**BELOW:** Patent filings for cannabis food and drink over time

**FIGURE 1**

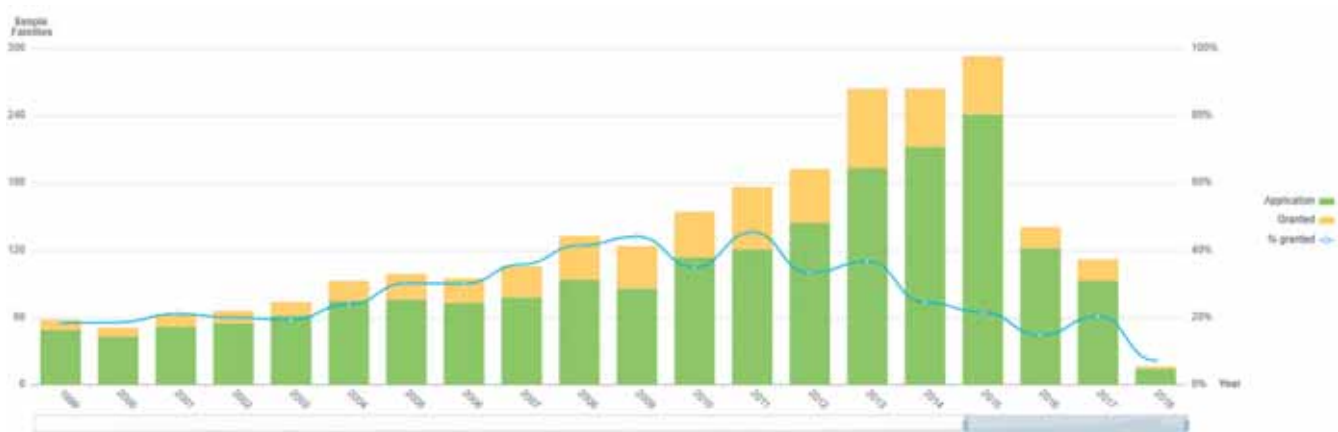
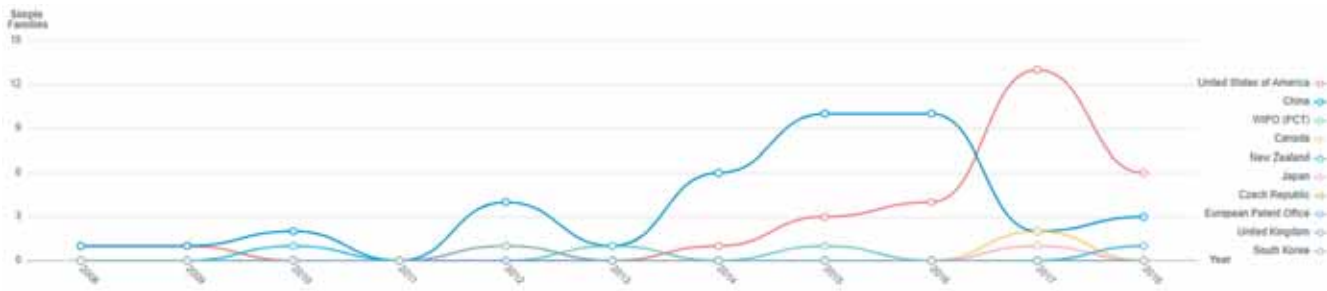


FIGURE 2



**ABOVE:** Patent publications for cannabis-infused edibles by country and by year

**CBD vs THC in edibles and beverages**

Cannabis is a complex plant containing more than 110 different cannabinoid compounds. Most edibles will contain either tetrahydrocannabinol (THC), or cannabidiol (CBD). THC-dominant edibles are consumed for both recreational and medicinal purposes, while CBD-dominant edibles are primarily used for medicinal purposes only. There is another aspect for food and beverage companies to consider, however. Says Christina Bellman, founder and CEO of automated oil-infuser company LEVO, "People are beginning to use cannabis to enhance different taste and flavour profiles. We are coming to understand that the marriage of culinary and cannabis can be an immersive experience."

**Innovation opportunities**

The report's findings point to two areas where the biggest opportunities for those filing cannabis patents lie. First, in specific cannabinoid and terpene profiles and formulations, and secondly, in industrial-scale fermentation approaches to production that can deliver specific, quality-assured cannabinoid profiles for use in food and beverages.

Specific formulations derived from cannabis distillation methods provide fertile ground for

potential patent protection. The majority of pure THC or CBD distillates remove the terpenes in cannabis, providing a highly potent distillate that can be added to almost any recipe. Terpenes are key to the smell and taste of cannabis and are believed to interact synergistically with cannabinoids to improve the efficacy of medical marijuana.

The ability to add distillate to almost any recipe combined with the ability for producers to more accurately dose their products via distillates makes this delivery mechanism highly desirable. However, many producers are looking for ways to add the terpenes back in, in order to reintroduce certain flavour profiles unique to cannabis.

There is great potential for producers to ascertain precisely which terpenes are present in different cannabis strains (*C. indica*; *C. ruderalis*; *C. sativa*), and which of these terpenes should be added back to the distillate to achieve specific flavour, psychoactive, or medical effects. There is also potential for non-cannabis specific terpenes to be added back into distillates. New, novel methods around extracting, synthesising, and re-introducing terpenes, once patented, could provide a high level of competitive advantage.

**RIGHT:** Patent landscape for cannabis food and drink, showing where the high valuation patents are

FIGURE 3



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# The murky world of herb and spice fraud

Herbs and spices are things to be enjoyed. They add colour, flavour and aroma to so many of the dishes we like to eat. But there is a dark, murky side to the world of herbs and spices – one that world expert Professor *Chris Elliott*, of Queen's University, Belfast, set out to explore in his webinar.



HUNDREDS of participants around the world logged in for Professor Chris Elliott's webinar on fraud in the herb and spice sector, sponsored by Agilent, on 30 January. His presentation was typically engaging and touched on why fraud happens in this sector and what's being done to stop it. The full presentation can be accessed on our website, but meanwhile here are just some of the questions Chris tackled, along with his answers.



## What are the key drivers for food fraud in the herbs and spice sector?

The key drivers are first of all opportunity – with such long and complex supply chains there are so many ways that cheats can penetrate them. The second driver is the vast amounts of money that can be made from cheating. An industry valued at over \$20b with so many vulnerabilities is ripe for criminal activity. If even five percent of what's sold is fraudulent (which is a very conservative number) then around a billion dollars is being netted off by cheats. The final

driver to think about is climate change. So many crop failures are occurring around the world, which causes huge price spikes. When prices surge, it's another ideal opportunity for fraudsters to get involved.

The countries that produce and process the largest amount of herbs and spices are at greatest risk, obviously. We are working with companies in countries such as Turkey and India who realise that they are at greatest risk from the fraudsters.


## What technologies are currently available to combat this area of fraud?

Our main scientific weapon is the fingerprinting of many herbs and spices using a range of tools such as molecular spectroscopy and mass spectrometry. When we produce fingerprints of genuine herbs and spices we can quite easily spot when a batch has been tampered with in some way. Our work has led to quite a few detections of fraud over recent years and is gaining huge interest from many companies that want to protect their reputations and prevent criminals penetrating their businesses. When you are able to test the quality and authenticity of herbs and

spices using smart phones – something that's not that far away – combatting fraud will move to a new level, driven by technological advances.

## Can you see the situation improving?

I'm afraid I see even more issues ahead. Supply chains keep getting more complicated, crop failures have grown in number and criminals see more and more money to be made from food. However, the introduction of widespread fingerprinting across supply chains will at least make life a lot more difficult for the cheats. I do see a point when whole sectors will come together to join forces against fraud. This has already started to happen in the UK with the formation of the Food Industry Intelligence Network.

To join the wider debate about Food Fraud with Professor Chris Elliott, don't miss our conference, Moving from Food Fraud to Food Integrity, 28 February 2019. See [newfoodmagazine.com/events](http://newfoodmagazine.com/events) for details 

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# Towards healthier meat products

*Hanne Christine Bertram, Line Hjelm, Rebekka Thøgersen, Nina Eggers and Line Ahm Mielby* of the Department of Food Science, Aarhus University, Denmark, look at recent innovations in the meat-product sector, with particular emphasis on hybridised products and nutri-functionality by metabolomics.

## ABOUT THE AUTHOR



**HANNE CHRISTINE**

**BERTRAM** is Professor in food metabolomics at Aarhus University, Department of Food Science and her research focuses on deciphering biofunctionality of animal-derived foods. Prof. Bertram thrives to create strong collaborations between academia and industry. She has authored some 160 peer-reviewed papers and received several prestigious research awards.

### Meat is nutritious and important

Meat is a highly nutritious component of our diet. It provides all the essential amino acids that our bodies need, and the bioavailability and digestibility of meat proteins is strikingly high.<sup>3</sup> In addition, meat is a vital source of minerals and vitamins; especially vitamin B12 – something that is often lacking in sufficient amounts within a vegetarian diet.<sup>9</sup> But how can meat products become even more attractive from a nutritional perspective? A recent trend in food innovation is the introduction of hybridised products, where animal-derived and plant-derived ingredients merge to form a new hybrid. In many ways, this is an attractive strategy as it combines the best of the animal world with the best of the plant world. A vast amount of evidence supports the notion that intake of dietary fibres originating from plant-based materials possesses multiple health benefits. These can largely be ascribed to the fact that they stimulate a health-promoting metabolic activity of the microbiota harboured in our gut.<sup>10</sup> Given this evidence, attempts have been initiated to introduce dietary fibres into meat products. In academia, activities in this area are not new and reports on

the introduction of a variety of dietary fibre sources can be found in scientific literature.<sup>7</sup>

### Dietary fibres – mode of action

Dietary fibres constitute carbohydrates that are resistant to the digestive enzymes in the gastrointestinal tract and thus pass unaltered to the large intestine. In the large intestine, these dietary fibres may act as substrates for the gut microbiota. During fermentation of dietary fibres by the gut microbiota, so-called short-chain fatty acids are generated. These include acetic acid, propionic acid and butyric acid.<sup>6</sup> There is considerable evidence to suggest that the short-chain fatty acids – in particular, butyric acid – beneficially impact the epithelial cells in the intestine, where they act as energy substrates that promote healthy and well-functioning intestinal cells.<sup>12</sup> In addition, research also indicates that butyric acid is a key trigger in the gut-brain axis and is thought to be involved in the regulation of satiety and other essential systemic mechanisms, such as blood-pressure regulation.<sup>4</sup> Thus, when probing the beneficial effects of dietary fibres, short-chain fatty acids are key.

## ABOUT THE AUTHOR



**NINA EGGERS** is a laboratory technician at Aarhus University, Department of Food Science. Ms. Eggers has some 25 years of experience in food research and works intensively within sensory science, training sensory panellists and carrying out descriptive sensory analyses.

## ABOUT THE AUTHOR



**REBEKKA THØGERSEN** is a PhD-student at Aarhus University, Department of Food Science. She works on the development of healthier food products using metabolomics, with a focus on modifying meat products for the purpose of reducing possible harmful meat-induced effects on colon health.

**LEFT:** Results from a consumer survey (n=32) where three sausages were served; a standard sausage (fat content 25.5% w/w), a sausage containing 5% w/w rye bran and 1% w/w collagen (Scanpro 1015-1) (fat content 12.5%), and a sausage containing 3% w/w rye bran and 3% w/w collagen (Scanpro 1015-1) (fat content 10.7%). The participants were asked to evaluate the sausages on a scale ranging from 0 to 9 according to how much they liked them. Letters a and b in the figure indicate statistical difference (P<0.05).

## Metabolomics for documentation of beneficial effects

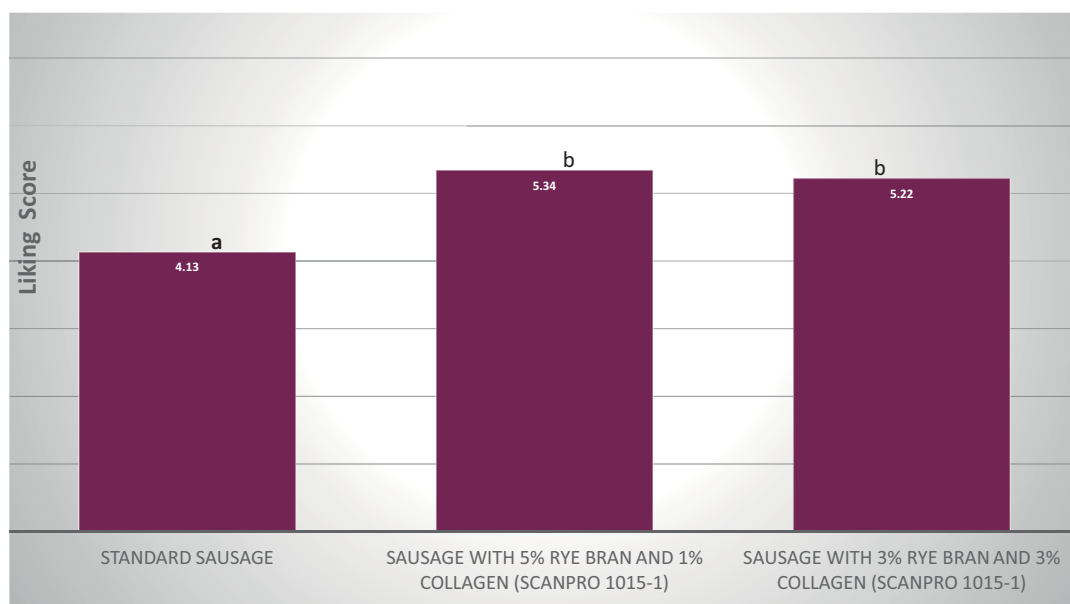
Despite several research studies having explored the technological aspects of the addition of dietary fibres to meat products, few studies have actually investigated whether fibre enrichment of a meat product results in a food with enhanced nutri-functionality. Thus, evidence that fibre addition to meat products improves their nutritional value has been lacking. Metabolomics represents a modern and advanced technique for capturing our metabolic signature. Recently, metabolomics has been developed for investigations into how diet influences our endogenous metabolic response, thereby facilitating a more detailed understanding of how diets impact us.<sup>2</sup> To shed light on how nutri-functionality of meat products may be enhanced through fibre enrichment, we recently developed a frankfurter-like pork sausage containing six percent inulin (Orafti HP from Beneo-Orafti, Belgium) and compared it with a corresponding control sausage identical in macro-composition. Under a controlled experimental set-up, the sausages were fed to healthy rats as their sole diet for a period of four weeks. Through metabolomics analyses of blood and faecal samples collected from the rats fed the sausages, we examined how the inulin-enriched sausages influenced the profile of metabolites circulating in the blood and excreted in stools.<sup>11</sup> Intriguingly, the results showed that the metabolome could differentiate between rats fed the standard sausage and the inulin-enriched sausage, respectively. Rats fed the inulin-enriched sausage had higher levels

of short-chain fatty acids such as butyric acid, propionic acid and acetic acid in their stool and blood plasma.<sup>1</sup> Thus metabolomics convincingly demonstrated that the health benefits associated with intake of dietary fibres are obtained when those fibres are incorporated into meat products. From this we can conclude that a huge and favourable potential for developing innovative and health-promoting meat products based on fibre-enrichment exists, as documented by an advanced metabolomics approach.

## Consumer acceptance trumps all

A prerequisite in the launch of new and healthier meat products is that they should be tasty, delicious and meet consumers' expectations and demands.<sup>1</sup> Taste is indisputably a pivotal and decisive parameter that determines how we perceive and assess any food product. The texture of a food product is also integral to our perception of it. We have very clearly defined expectations regarding the texture of food products: chips must be crispy, beef must be tender and juicy, and meat sausages must have the right 'bite'. Taste and texture are therefore the most challenging attributes in the introduction of new and healthier meat products when ingredients such as fat are reduced or replaced with new ingredients that may have a distinctly different influence on taste and texture. In addition, when plant-derived materials such as dietary fibres are included as ingredients in meat products to create hybrid products, the plant-based materials will often be responsible for a distinctive and undesired contribution to the taste,<sup>7</sup> with product texture often being compromised.<sup>8</sup> ▶

FIGURE 1



**RIGHT:** The hotdog is one of the oldest fast-food concepts. Recently, the hotdog sausage has enjoyed a revival via the gourmet hotdog concept. Now, innovations in the meat industry mean the nutritional profile of the hotdog sausage can be improved.



**Ingredients facilitate innovative and healthier meat products**

Ingredients find use in many food innovations, where they help facilitate desired attributes of food products. Consumers are also increasingly aware as to whether or not ingredients can be categorised as artificial or natural additives. Collagen extracted from skin and hides is a natural ingredient that finds use in the meat industry. Collagen's keen ability to create strong protein-water interactions makes it a superior ingredient to promote water-binding capacity. In this way collagen ingredients enhance product firmness and promote a desirable texture in sausage products, which is crucial for consumer acceptance. To investigate whether

these attractive attributes of collagen could aid in the inclusion of health-promoting dietary-fibre ingredients that may modify product texture, we recently conducted a scientific study where combinations of fibre-rich rye bran (Skærtoft Mølle, Denmark) and collagen were included in Frankfurter pork sausages.<sup>5</sup> In this study – carried out in collaboration with Essentia Protein Solutions A/S – a range of Frankfurter sausage recipes with different combinations of rye bran (included in levels between 3 and 6% w/w) and collagen (Scanpro 1015-1 and Scanpro 1015-3 included in levels between 1 and 3% w/w) was developed. By including a combination of rye bran and collagen, a 50 percent reduction in fat content was achieved, clearly improving

ABOUT THE AUTHOR



**LINE HJELM** obtained her Master of Science in Molecular Nutrition and Food Technology from Aarhus University in summer 2018. During her Masters thesis, she worked on fibre enrichment of sausages, emphasising technological aspects with low-field NMR and texture profile analyses. Her interests include development and improvement of food products and ingredients.

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the nutritional profile of the sausages. The technological attributes of the sausage products were examined by various instrumental analyses, such as texture profile analysis and low-field NMR, and the sausage products were also evaluated both blindly and objectively by a trained sensory panel. The results clearly demonstrated that through the addition of collagen, product texture could be modified.<sup>5</sup> Furthermore, the collagen ingredients were found not only to impact textural attributes, but their inclusion also strikingly impacted taste attributes of the sausages,<sup>5</sup> probably because the natural collagen ingredients originating from pork skin also provide important meat-like flavour precursors to the sausage product. Consequently, through the addition of collagen, the overall acceptance of rye-bran-enriched sausages was improved. A small consumer survey (n=32) confirmed that the combination of rye bran and collagen inclusion represents a favourable sausage product solution, as the study showed that consumers preferred sausages containing either five percent rye bran/one percent collagen or three percent rye bran/three percent collagen as compared with the standard sausage (**Figure 1**).

“ *There is considerable evidence to suggest that the short-chain fatty acids – in particular, butyric acid – beneficially impact the epithelial cells in the intestine* ”

### Conclusions

Ingredients can aid the development of healthier meat products by providing active ingredients such as dietary fibres that improve the nutritional profile of the products and by providing functionality that facilitates attractive product attributes that meet consumers' expectations. With increasing consumer awareness and interest in healthy food choices, it is anticipated that hybridised products, where attractive plant-based components are integrated into more traditional meat products, will dominate future innovation in the meat industry. Ingredients have emerged as a successful and key element in food innovations and they are predicted to play an important role in the development of new hybridised products where 'healthiness' is a key driver. Any ingredients, however, must meet and fulfill consumers' perception of 'natural' and their preference for so-called 'clean label'. 

### ABOUT THE AUTHOR



**LINE AHM MIELBY** is a Post Doc student at Aarhus University, working within sensory and consumer science in Food Quality Perception and Society at the Department of Food Science. Dr. Mielby thrives in applying sensory and consumer techniques in interdisciplinary projects.

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# Microbial process validations: from study design to in-plant execution

In a lively webinar that took place on 12 December 2018, **Pablo Alvarez-Martin**, Chief Scientific Officer, Novolyze, provided an overview of current validation strategies and answered a range of questions, detailed below.

## Why are surrogate organisms of such importance in ensuring the safety of processed foods?

Because the presence of pathogens in food can be sporadic, pathogen testing on finished goods is insufficient to ensure the safety of processed foods. The probability of detecting pathogens using conventional methods is very low, requiring a large number of samples. Surrogate organisms are non-pathogenic bacteria that mimic the inactivation of foodborne pathogens under different kinds of stress, such as heat. Due to their safety, surrogates are used directly at the factory to test processing systems. The food is first inoculated with the surrogate at higher and controlled concentrations. The inoculated food is distributed in the process to validate. Samples are recovered and enumerated for survivors. Let's take the example of a roasting system for cocoa nibs, where the microbial performance criteria is to inactivate 6-log of *Salmonella* – in other

words, the roasting step has to inactivate 99.9999% of *Salmonella*. In order to prove a 6-log reduction, a high inoculation level with the surrogate has to be targeted, say 8-log CFU/g or 100 million bacterial cells per gram. The cocoa samples are then distributed in the roaster to validate using 'routine' worst-case parameters. Post-roasting samples are collected and the surrogate is enumerated. If the counts are below 2-log CFU/g or 100 bacterial cells per gram, the test results are positive: The roaster was capable of inactivating 99.9999% – 6-log – of the surrogate, and of *Salmonella* by correlation. Using surrogate organisms



results in very robust data to confirm that a system has been properly implemented and reaches a target microbial kill in a reproducible manner.

## What are the steps for conducting a proper validation study with surrogate organisms?

The first step consists in defining an appropriate protocol for the study. A standard practice is to focus the trials on worst-case conditions. From a product standpoint, an evaluation of the intrinsic properties can be performed. For instance, a food matrix with a lower water activity, lower moisture, higher fat content

will be considered as more conservative for pathogen inactivation. Preliminary microbial inactivation studies at lab scale can also be performed to confirm the worst-case matrix. The second step consists of selecting an appropriate surrogate organism for the trials. Surrogate selection activities may include the review of available literature as well as data from previous studies. The compatibility of a surrogate for a specific validation configuration can also be confirmed by conducting preliminary benchtop trials verifying its resistance compared with the resistance of a target pathogen of concern. The third step is to perform three independent plant trials. At that stage, food is inoculated with the surrogate and distributed in the system to validate. Post processing samples are recovered and enumerated. The comparison of counts before and after allows to conclude on the efficacy of the microbial reduction process. 📌

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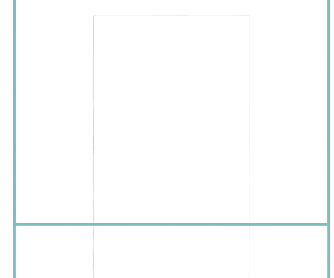
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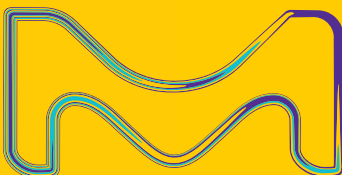


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