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FOOD ANALYTICS + FOOD SAFETY | FOOD PROCESSING + AUTOMATION
FUNCTIONAL FOODS + INGREDIENTS | LEGISLATION + LABELING

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Let's get into the autumn trade fair season!

Drinktec September 15 – 19, 2025, Munich

Circularity & Resource Management: Circular Economy in the Beverage Industry

How can the circular economy make beverage production more efficient and conserve resources? Which fields of action offer the greatest leverage for the beverage industry? As one of drinktec's three key themes, Circularity & Resource Management focuses exhibitors and visitors on pioneering solutions in the broad field of the circular economy.

Data2Value: Data-Based Value Creation in the Beverage Industry

Where does the beverage and liquid food industry stand on the topic of data-based value creation? How can future options be derived from data analysis? As one of the three key themes of drinktec 2025, Data2Value will become the leitmotif of many exhibitors' trade fair presence.

Lifestyle & Health: Consumption Trends in the Beverage & Liquid Food Industry

How do consumption trends influence the development of the beverage and liquid food industry? With the key theme of Lifestyle & Health, drinktec is bringing a global megatrend into the focus of exhibitors and visitors.

Fachpack, September 23 – 25, 2025, Nuremberg

The packaging industry will meet in Nuremberg from September 23 – 25, 2025.

FACHPACK is a central meeting place for the packaging industry and its users in Europe. The event has been held in Nuremberg for over 40 years. The packaging trade fair provides a compact yet comprehensive overview of all relevant topics in the packaging industry. This includes solutions for product packaging for industrial and consumer goods, packaging aids and materials, as well as for packaging production, packaging technology, logistics, packaging systems, and packaging printing.

In addition to these leading global trade fairs for the beverage and packaging industries, numerous smaller but also exciting conferences will take place: One example is the Fraunhofer Future Days on the conformity of food packaging from October 20 – 22, 2025, in Freising.

FOOD-Lab #3-2025 will once again present interesting contributions from leading companies and specialist authors in the run-up to these trade fairs.

I wish you pleasant reading.

Sincerely,

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MOSH/MOAH Analysis in Transition

Insights from the Instituto de la Grasa and LECO

Author: **Dr. Christine Loeb-Stubbins**,
European Field Product Manager Sep Sci, LECO

The analysis of mineral oil hydrocarbons (MOHs) — specifically MOSH (Mineral Oil Saturated Hydrocarbons) and MOAH (Mineral Oil Aromatic Hydrocarbons) — is one of the most pressing and complex challenges facing food safety laboratories today. These contaminants, often introduced during processing or packaging, are under increasing regulatory scrutiny across Europe and beyond.

Professor Wenceslao Moreda, Scientific Investigator at the Instituto de la Grasa (CSIC)

Many laboratories rely on LC-GC-FID, which is widely recommended for quantification. However, this technique does not confirm identity and struggles with interferences from biogenic substances, leading to false positives or negatives — a growing concern when legislation demands ever-lower limits.

To address this, LECO developed a GC×GC-TOFMS/FID workflow that enables both qualitative confirmation and quantitative accuracy. The Pegasus® platform combines the power of time-of-flight mass spectrometry with the robustness of flame ionisation detection, allowing analysts to identify, separate, and quantify even the most complex MOH profiles.

First-hand Insights from the Field

I had the chance to catch up with Professor Wenceslao Moreda, Scientific Investigator at the Instituto de la Grasa (CSIC), during a LECO-sponsored MOSH/MOAH workshop in Seville, Spain. His team has been exploring the potential of comprehensive two-dimensional gas chromatography (GC×GC) in routine analysis, particularly for edible oils such as olive oil.

Here are some highlights from our conversation.

"We need more research — the legislation is going faster than the science."

Dr. Loeb-Stubbins: What are your current research priorities at Instituto de la Grasa?

Prof. Moreda: We work on the analysis of oils in general, from quality and authenticity to residues and contaminants. This includes pesticides, polycyclic aromatic hydrocarbons, MCPDs, and now — increasingly — MOSH/MOAH.

"In olive oil, contamination is often close to the LOQ. That's a big issue."

Dr. Loeb-Stubbins: Why is MOSH/MOAH analysis so critical for your lab?

Prof. Moreda: The presence of MOSH/MOAH in olive oil is a major concern. Contamination levels are often right around the limit of quantification (LOQ). In some cases, even below it. This is especially problematic because the legislation is advancing faster than the research. We don't yet have all the information we need to confidently define limits for every food matrix.

"We chose LECO because it lets us quantify what's really there."

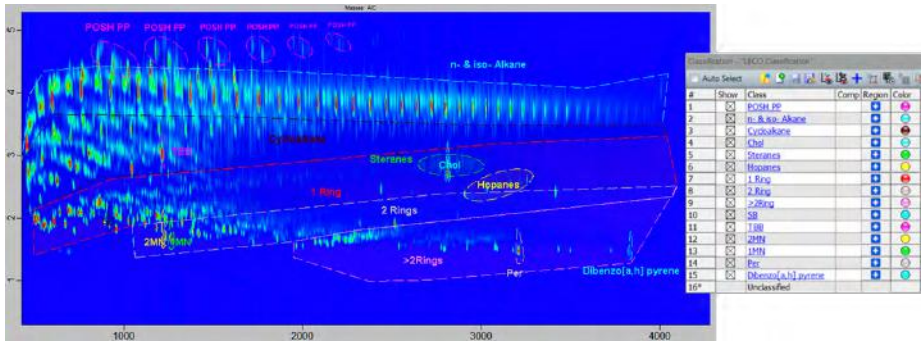
Dr. Loeb-Stubbins: Why did you adopt LECO's GC×GC-TOFMS/FID system?

Prof. Moreda: We need to be sure that the levels we report are not influenced by coeluting or biogenic compounds. The LECO system lets us remove that doubt. It provides confirmation, not just quantification. That's essential when the margin of error is so narrow.

"Automation reduces uncertainty."

Dr. Loeb-Stubbins: What has improved in your workflow?

Prof. Moreda: False negatives used to be a problem — often due to interferences or manual prep variability. Now, with automated sample preparation and GC×GC, we can reduce that uncertainty and increase reproducibility.



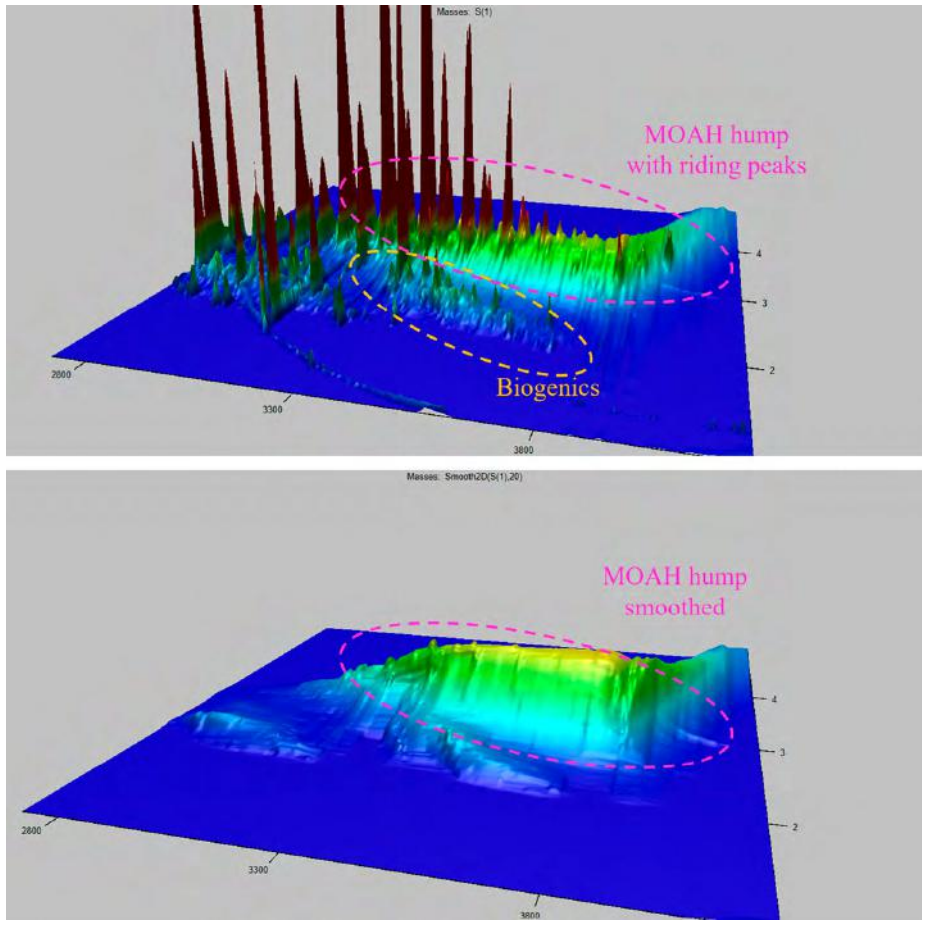
GC×GC space mapping using the LECO reference standard

"Even with other systems available, we keep using LECO."

Dr. Loeb-Stubbins: How does LECO compare to other systems?
Prof. Moreda: We have access to several instruments from different manufacturers, but LECO's software and spectral clarity stand out. Even with relatively few samples, it's important to minimise uncertainty and understand what's actually in your sample.

"You need to change your perspective — but this is the future."

Dr. Loeb-Stubbins: What would you tell analysts thinking about moving to GC×GC-TOFMS/FID?
Prof. Moreda: It's a shift in mindset. You're no longer just looking at one or two dimensions — GC×GC gives you a third dimension: concentration clarity. The learning curve is worth it. With LC-GC-FID, you still have an unresolved complex matrix. With GC×GC-TOFMS/FID, you can see the compounds clearly and separate them from biogenic interferences. This will be the future of MOSH/MOAH analysis.



Separation of biogenic compounds Bottom – MO Software tool applied showing cleaned hump

Understanding the Timeline of Regulatory Pressure

During his presentation, Prof. Moreda shared a slide showing how regulatory deadlines are pushing faster than analytical readiness. Here is a simplified version of that timeline:

Summary

The Instituto de la Grasa's early adoption of GC×GC-TOFMS/FID illustrates how research labs can stay ahead of regulatory curves — even in complex matrices like edible oils. With transparent separation, automated processing, and dual-detection power, LECO's workflow enables laboratories to move beyond uncertainty.

As Prof. Moreda put it: "We chose this system to be confident in our numbers. That's what matters most."

MOSH/MOAH Legislative Timeline (EU)

Year	Development
2020	First EFSA risk assessments highlight genotoxic potential of MOAH
2022	Increased pressure on food producers to report MOSH/MOAH levels
2023	EFSA's updated guidance on MOH in food published (EFSA Journal 2023:8215)
2024	ISO 20224 standard released, promoting harmonisation of workflows
2025	LOQ limits likely to enter legislation for multiple food groups
2026+	Expected full enforcement of threshold limits across EU food categories

MOSH/MOAH COMPLIANCE WITHOUT COMPROMISE

The Regulations Are Clear. Your Results Should Be Too.

STAY AHEAD WITH LECO

Mineral Oil Hydrocarbons are under increasing scrutiny from EFSA and JRC guidance, with strict requirements for accurate monitoring in food and packaging. Conventional LC-GC/FID often falls short in specificity and confirmation.

LECO's **Pegasus® BTX GC×GC-TOFMS/FID** is the first validated workflow to deliver both:

- ***Qualitative insight***
  To separate MOSH from MOAH, and identify contamination sources
- ***Quantitative accuracy***
  That meets EFSA recommendations
- ***Regulatory confidence***
  Backed by custom reference standards and full system verification

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EATC, BERLIN | FRIDAY, 19 SEPTEMBER

See the workflow in action. Learn how advanced separation, automated data cleanup, and validated methods provide the clarity and confidence regulators demand.

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WHY LECO?

Since 2020, LECO has been the only provider offering ***a complete MOSH/MOAH solution*** *— combining cutting-edge instrumentation, intelligent software, and hands-on training.*

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LECO
EMPOWERING RESULTS

Cultures. Taste. Technology.

The success story of the M FOOD GROUP® www.m-foodgroup.de

The interview was conducted by Editor-in-Chief Th. F. W. Kützemeier

The backbone of the German economy is the middle class (SMEs), and like yours, these are predominantly owner-managed family businesses. Hence the question: How did you come up with the idea of founding the M FOOD GROUP® 25 years ago?

Gregor Scheffer (GS): I graduated from the Kulmbach Technical College for Meat Processing Technology and qualified as a state-certified meat technician. The fall of the GDR occurred in my first year of work in 1989. Nobody had predicted it. My first stop was at Zimbo. In 1997, I became self-employed, initially working as a freelance sales representative for spices. The company I was working for at the time was sold in 1998, and then, together with a product developer, I decided to start our own business. That was the birth of our company, M FOOD GROUP®, which also incorporated my trading agency—although Meat Cracks GmbH was the first company since its founding.

How many employees does the M FOOD GROUP® have today?

Dominik Scheffer (DS): Currently, 145 employees work here, up from just 4 about 25 years ago.

How did you find entering the market back then?

GS: The market was completely saturated, as there were already well-known suppliers of herbs and spices. However, thanks to my good contacts in the industry, we were fortunate enough to receive an order from a major regional supplier in 2002 to redesign pizza toppings. We were able to contribute our very specific technological know-how to this collaboration and quickly became successful.

FOOD Lab expert discussion with M FOOD GROUP® founder and CEO **Gregor Scheffer** and shareholder and CSO **Dominik Scheffer**

Where did you get this know-how?

GS: I have always been fascinated by both raw sausage and salami production and microbiology, and I have continually expanded and applied this knowledge. Our deep understanding and expertise have continued to grow over the years, not least through close collaboration with Kulmbach and numerous scientists who have continued to push the boundaries of knowledge in their research. We have benefited greatly from this.

But if the market was already saturated in 2001, how did you still manage to break into it?

GS: Our claim is Cultures. Taste. Technology. We had this technological approach. We always said we had to combine these components. Technology is linked to technical equipment and application, as well as to good product advice. Therefore, we always consider the entire context, meaning the knowledge of taste and texture through cultures and spices and applied technology. That was our strength and remains one of our unique selling points (USP). That's why we are now one of the market leaders in Germany and Europe in the supply of technological components for the salami pizza sector. Few people know that a large portion of pizza production in Germany and Europe comes from us. But it's true: we have optimally trained our customers so that they can basically rely on us for advice at any time and can rely on our assistance in case of problems. This has created a high level of trust.

Did the location decision play an important role in the company's development?

DS: For us, Steinfeld-Mühlen is a good location, close to renowned Westphalian meat and sausage producers, whom we also call our customers. A further boost came in 2008/9 when we established the Eastern European salami business for a well-known, large company.

How do you bridge the language barrier?

DS: We work with 18 local sales partners in various countries and regions who are fluent in the respective languages in Ukraine, Poland, Moldova, as well as in Latin America, the Arab world, Australia and the USA, among others, and who are very familiar with the mentality, culture, and, above all, the legal situation.

How is the group positioned today, also in light of the looming generational change?

GS: It all began with Meat Cracks Technology GmbH, which focused on specialized solutions for meat and sausage products. This gave rise to the M FOOD GROUP® – a company that is now highly networked and globally successful. With an international partner network and cutting-edge technology, we develop customized ingredients for various food applications. Since those earliest beginnings, we have continuously evolved and changed our shareholder structure in 2017. Since then, my son has been involved, as well as a minority shareholder who, with his engineering expertise, is expanding the biotechnology field for us. Everyone is talking about company succession: we have successfully solved this issue together and – as far as my son is concerned – involved from the ground up. We will scale this company and continue to drive growth.

DS: We're not looking in the rearview mirror. We're constantly looking to the future. You and many visitors could see that at IFFA; the energy, the passion that goes into the company, our product range, including innovative vegan products like vegan chicken nuggets... all of this proves and demonstrates our determination and spirit. In 2017, we once again became independent of the market with our own starter culture production. We select the germ from the Petri dish and are able to offer everything from a single source, right up to the finished salami. This makes us the only company with this expertise. That's why, contrary to the general market trend, we're experiencing double-digit growth. Since 2001, we've been heavily diversifying. In product development alone, we have 18 colleagues supporting us. Our approach is completely customer-specific. We blend 1909 different products. We can do this not only for the meat industry, but also for the delicatessen and fish industries. With the establishment of Microtec GmbH, we decided to complete the supply chain. We can supply everything from microorganisms to ingredient mixtures. Our end product is always a powder mixture or a freeze-dried starter culture. Our process-oriented product development experts have, in some cases, established international lines and possess extensive knowledge of flow behavior, viscosity, and stability. Thanks to this excellent pool of colleagues, we have internalized the knowledge of technological processes in the industry and can therefore provide our customers with optimal support.

GS: An example of a solution to a technical problem we worked on for a year and a half: a foreign customer, a manufacturer of mold-cured salami in natural casings, caliber 60, produced on Italian-made machines and curing equipment. We converted production to our technology and thereby created an exclusive product that is unparalleled.

How did you identify this problem company and solve the problem?

GS: We had a new culture, CF10, so-called nitrate reducers for cured ham and their applicationsThe highlight is that these bacteria reduce nitrate even at cold storage temperatures of just 3 degrees Celsius. We promoted this product in the market, including social media and telephone acquisition, and that's how the company in question found us.

DS: This is the core business of our Microtec GmbH: isolating new strains, identifying their technological significance, and highlighting the added value for the customer. Among other things, our subsidiary Microtec GmbH, our biotech service provider, is running a culture promotion. We are looking for larger dairy units that have their own strain collection and want to outsource this collection to us, i.e., have it produced by us, i.e., contract manufacturing. For example, we have specialized knowledge in the field of propioni cultures and their potential to optimize cheese perforation, such as in Emmental.

Because we already have all the biochemical processes and the reddening process in place at 4 degrees Celsius, we save considerable processing time. Added to this is the protease and lipase activity, which we use to infuse the product with a real punch of flavor. With the help of bio-

technology, we create significant added value for our customers.

Do you have this very specific expertise yourself?

DS: Yes, we have our own extensive R&D department. We have microbiologists and biotechnologists who work closely with the Food Division to develop products, always closely connected to the market. They ask themselves which trends are emerging in the market, what we need to consider, and which strains we need to develop that reflect these market trends.

That's the big difference between basic research and your application-oriented development.

DS: That's right. As you can see in our image video, we develop sample salamis, which we produce in our pilot plant, where we integrate new cultures or optimize projects in cooperation with customers. We operate exclusively in the food industry. Producing such samples in industrial production is extremely difficult. Therefore, we offer our customers the opportunity to produce such samples on our pilot plant facilities, where all the machines are available in miniature. We can therefore map all processes here, from initial development to series production. This saves our customers the sample slots on their systems. This optimizes and fixes ingredient parameters, culture parameters, and plant parameters, making scaling to industrial scale much easier.

GS: Added to this is the unspoken expectation that our customers receive a very high level of technological performance. Customers are always grateful for the complex technological knowledge that they could only acquire themselves with great effort.

How did you come up with this idea?

DS: We wanted to capture and offer added value. We work with food, the ingredients are finally available...and we want to work long-term and sustainably.

Speaking of vegan food. What are you doing in this area?

DS: As already demonstrated at IFFA, we want to combine proteins from the bioreactor with our products. We purchase mycoproteins. The amino acid profile is very interesting. This reduces the need for additives. We have gained considerable expertise and already have many delicious vegan products in our portfolio.

Keyword: chemistry set. How far has the clean label approach developed? If this trend continues, vegan products will eventually be superior to the original products because vegan ones no longer require additives, while the original mortadella certainly does.

DS: Ingredient lists are shrinking; methylcellulose, for example, is becoming increasingly unpopular with both manufacturers and retailers. Our suppliers are also working on this.

The future belongs to mushrooms because they are more adaptable than other proteins in terms of taste and texture. They are not subject to the Novel Food Regulation. We label them as mushroom protein or mycoprotein. No problem.

What is the trend in spice blends?

DS: We continuously adapt to market trends. The market is constantly calling for innovations, for example, during barbecue season when it comes to the question of how spicy should it be and what flavor? We are less active in Asia, also for sustainability reasons.

Do you also consider sustainability in your process chains, for example, which means of transport are used to transport the products and raw materials?

DS: We have the entire supply chain in mind. Many already require the carbon footprint. I see that many want it but aren't yet willing to pay 100%. This is a major factor for us, as we can export certified sustainability because, while we have few raw materials, we have engineering expertise like few other countries. Sustainability is an important factor in our expertise. This comprehensive expertise means that we retain knowledge.

Where are you headed?

DS: We are becoming a high-performance company in the fields of food and biotechnology, combined with technologies and ingredients, and we will continue to grow. We also plan to establish a professional academy for young food professionals starting in 2026/2027 to train four to five young people each year and offer them a job guarantee. We are not afraid of knowledge migration. We also hope to strengthen our branches abroad and expand our network. The background is that we are increasingly struggling with the fact that almost no specialists are being trained anymore.

GS: Our new production hall will officially open in October, and we'll be exhibiting at the FIE in Paris in December. We want to continue growing. Currently, we still meet the SME criteria, but we want to expand significantly, with a lot of passion.

Thanks for the interview!

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Giving the future a familiar taste

The science behind making plant-based meats (PBMs) as good as the original

Author: **Dr. Jan Peter Mayser**, Manager Food Market at Shimadzu Europa GmbH

New products often only gain acceptance by emphasizing how much they resemble older products. This applies in particular to conceptually innovative or disruptive products. A classic example is the automobile, which was originally called the "horseless carriage" to make it seem familiar – even though it was actually a revolutionary new invention that would change the world forever.

One of today's innovative new products are plant-based alternatives to meat. The potential market is huge, as these new foods address issues and concerns ranging from personal health and ethics to food security and the environment. So companies are investing heavily in giving these new foods the look, feel, smell, taste and texture of real meat as well as in meeting various other regulatory and consumer demands. How exactly are they doing all that?

Plant-based meats (PBMs) are becoming increasingly popular. More and more consumers are opting to go meat-free, whether out of concerns for animal welfare, personal health, their carbon footprint or in support of more sustainable agricultural practices (Figure 1). Or perhaps because of all of the above: By reducing or eliminating meat from their diets, individuals can decrease their risk of chronic heart disease and cancer, help mitigate deforestation and greenhouse gas emissions associated with the livestock industry and align their values with a more compassionate approach to food consumption.

They can also help ensure global food security. Not only is the world's population rising, but numerous climate-related and other factors are expected to affect how well we will be able to feed one another in the years ahead. Meat alternatives offer the potential to feed a growing population by using our limited resources more efficiently, since meat and animal-based proteins require more resources per kilogram to be produced than plant-based alternatives. To put it another way: Expanding the development of plant-based meats satisfies many different appetites.

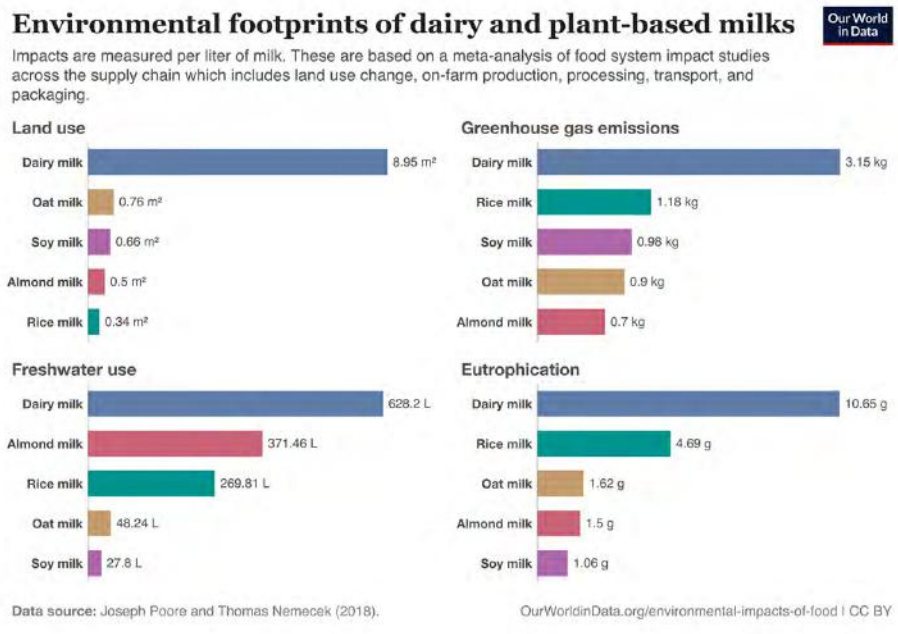

Figure 1: Environmental impact of different protein sources

Gaining acceptance through analysis

Despite the many reasons why a consumer might desire to buy a plant-based meat substitute, whether they actually do so will depend on several factors. For instance, further increasing the popularity of plant-based alternatives requires that these foods better imitate their traditional meat counterparts. At the same time, plant-based foods must be reliably tested in areas ranging from protein and fat content to the presence of pesticides, herbicides and allergens.

If the goal is to increase consumer acceptance and expand the safe commercialization of these new foods, the means to do that are to be found in expert analysis by qualified people and quality instruments. At the end of the day, success can only come by testing and measuring how well and how safely a particular PBM food formulation resembles the meat-based product it is intended to replace.

Sensory testing: The human touch

One of the ways that manufacturers of PBMs use to ensure that their products replicate the end-user experience of real meat is sensory testing. Human sensory evaluation involves the testing of a product's sensory characteristics by trained panelists. Characteristics of interest include appearance, aroma, taste and texture. Panelists are trained to use their senses to objectively evaluate the sensory attributes of a product and provide feedback on its overall quality. For plant-based meat alternatives, sensory testing is important, as it provides information on how the product will be perceived by consumers. By obtaining feedback from a panel of trained sensory evaluators, manufacturers can make adjustments to improve the user experience of their PBMs.

One common method of sensory testing is discrimination testing, where panelists are asked to compare two or more samples of plant-based meat alternatives and determine if they can detect any differences between them. Another type of sensory testing is descriptive analysis, where trained panelists are asked to rate the intensity of specific sensory attributes in a product, such as saltiness, umami (savoriness) or juiciness. A third type – consumer testing – involves asking a group of consumers to taste and evaluate a product and provide feedback on its sensory characteristics.

These types of testing help manufacturers to understand the sensory profile of their products as well as consumer preferences and to identify any sensory differences between their products and real meat. They then use the results to make adjustments to their products to better replicate the sensory experience of real meat and to better meet consumer expectations.

Sensory testing by expert instruments

In addition to testing by human experts, sensory testing is also being carried out by precision lab instruments. Figure 2 shows an example of sensory testing by instrumentation in which a plant-based meat is compared with an organic beef sample. A gas chromatograph is obtained for each of the samples and compared. The gas chromatograph run shows the more volatile and semi-volatile compounds within the food sample. These compounds are primarily responsible for the taste and odor structure of a food, and they have been well characterized, making it possible to clearly associate the compound with the taste or smell. The comparison of the chromatograms shows that there is already a large overlap in odor-active compounds between the samples. This suggests that they have a similar taste profile, while clear differences can still be seen. For example, Maltol is identified in the PBM. This gives the alternative meat a caramel-like, burnt aroma.[1] Nonanal is identified in both samples: Its purpose is to give a citrus-like,

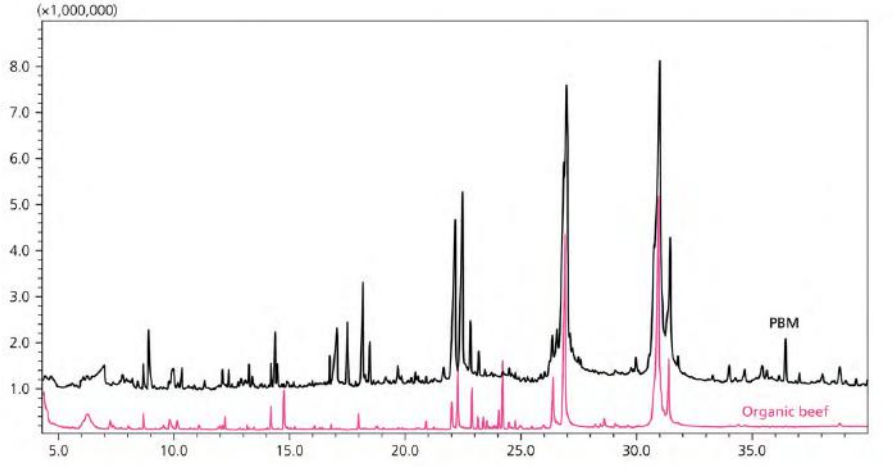

Figure 2: Overlaid representative chromatograms for PBM (black) and organic beef (pink) at 10-min extractions with the SPME Arrow

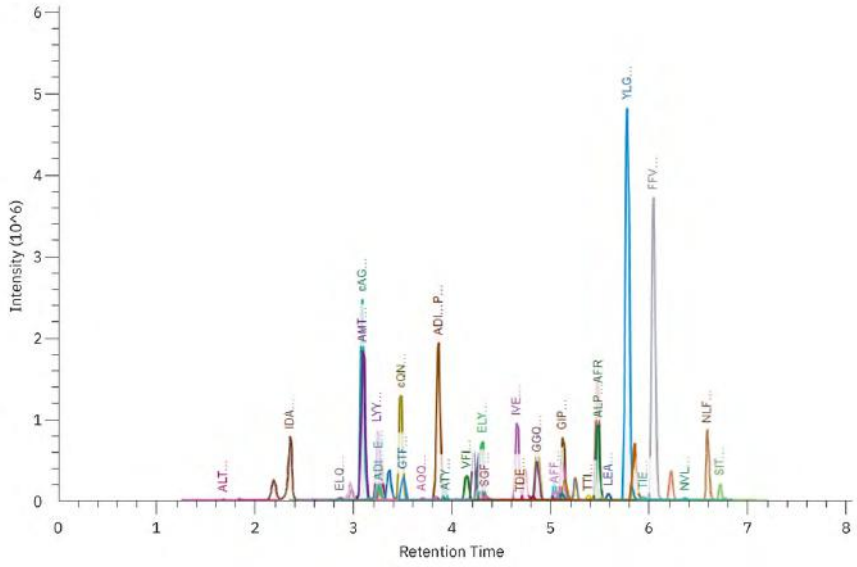

Figure 3: Chromatogram of a mixture of milk, eggs, cod, shrimp, lobster, almonds, Brazil nuts, cashew nuts, hazelnuts, walnuts, peanuts, wheat and soybeans

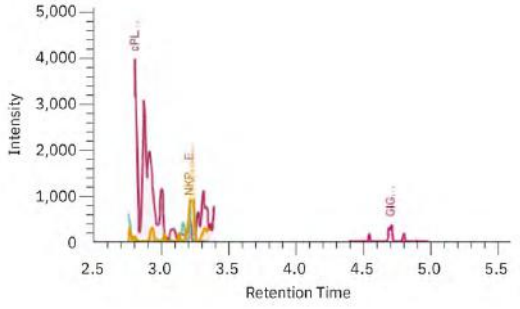

Figure 4: Soybeans in frozen pasta containing allergens

waxy flavor.[2] This analysis and sample preparation was conducted on a Shimadzu GCMS-TQ8050 NX in combination with an AOC-6000 sample preparation station (Figure 5).

Allergen testing: Safety, compliance and quality

While plant-based foods are often thought of as inherently safer than animal products, the reality is that many common allergens, such as nuts, soy and wheat, can be present in these products. Therefore, it is essential that food manufacturers conduct thorough allergen testing to ensure the safety of consumers with food allergies.

Cross-contamination: One of the primary reasons why allergen testing is crucial for plant-based meat alternatives is the risk of cross-contamination during the manufacturing process. Many plant-based meat alternatives are produced in facilities that also process allergenic ingredients, increasing the risk of accidental contamination. Without proper testing, consumers with food allergies may unknowingly consume allergens that could trigger severe reactions.

Novel ingredients: The use of novel ingredients in plant-based meat alternatives, such as pea protein or seitan, may also pose a risk for individuals with allergies to these ingredients. While they are generally considered safe for the majority of consumers, individuals with specific allergies must be cautious and rely on accurate allergen testing to determine if a product is safe for consumption.

Regulatory compliance: In addition to the critical safety concerns for consumers with food allergies, proper allergen testing plays a vital role in ensuring regulatory compliance across the global food industry. Millions of individuals are affected by food allergies, and even trace amounts of certain allergens can trigger severe, potentially life-threatening reactions. As such, accurate testing is essential not only to protect public health but also to uphold the integrity and safety of the food supply chain. Regulatory bodies around the world, including the United States Food and Drug Administration (FDA) under the Food Allergen Labeling and Consumer Protection Act (FALCPA), and the European Food Safety Authority (EFSA), have established strict guidelines that mandate food manufacturers to clearly identify and label the presence of major allergens – such as peanuts, tree nuts, milk, eggs, fish, shellfish, soy, and wheat – on all packaged food products. Non-compliance with these regulations, whether due to inadequate testing protocols or labeling errors, can lead to serious legal repercussions, including product recalls, fines, lawsuits, and damage to brand reputation. Therefore, implementing rigorous allergen testing procedures is not only a legal obligation but also a fundamental aspect of responsible food manufacturing and consumer protection.

Quality control: Allergen testing can also help food manufacturers optimize their production processes and prevent costly recalls. By implementing robust allergen testing procedures, companies can identify and eliminate potential allergen contaminants early in the production process, reducing the risk of contaminated products reaching consumers.

Cross-reactivity: Finally, food manufacturers must consider the potential for allergen cross-reactivity when conducting allergen testing for plant-based meat alternatives. Cross-reactivity occurs when pro-

Figure 5: GCMS-TQ8050 NX in combination with an AOC-6000 sample preparation station

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teins in one type of food trigger an allergic reaction in individuals who are allergic to different foods. By conducting comprehensive allergen testing, food manufacturers can identify potential cross-reactive allergens and take appropriate steps to address and label these in their products.

A new, time-saving method of allergen testing

Allergen testing for plant-based meats (PBMs) can be challenging due to their complex and often highly processed nature. These products frequently contain a wide array of ingredients – such as soy, wheat, peas, nuts, and legumes – that are common allergens. Additionally, the ingredients may undergo various processing steps or originate from different suppliers, increasing the risk of cross-contamination or unintended allergen presence. This complexity makes allergen testing not just a regulatory necessity but a vital aspect of consumer safety. Accurate identification of allergens is essential to prevent potentially life-threatening allergic reactions in sensitive individuals. To ensure comprehensive detection, food manufacturers must employ a combination of testing methods, including enzyme-linked immunosorbent assay (ELISA) and polymerase chain reaction (PCR). These methods help verify ingredient integrity, confirm labeling accuracy, and ultimately build consumer trust in plant-based meat alternatives as safe and reliable food options.

A new method – recently developed by Shimadzu – compensates for this complexity by providing a time-saving analytical solution. Figures 3 and 4 detail how LC-MS/MS – specifically, a Nexera X2 Ultra HPLC and a LCMS-8050 – was used to check for 13 different food allergens in a single run. The method is capable of identifying the eight allergens FALCPA recommends (milk, eggs, fish, crustacean shellfish, tree nuts, peanuts, wheat and soybeans) as well as the expanded list recommended by EFSA (gluten, milk, eggs, nuts, peanuts, soybeans, fish, crustaceans, molluscs, celery, lupin, sesame, mustard and sulphites). A total of 245 transitions were set to monitor 50 peptides selected from 21 proteins. Allergens were found in both raw foods and cooked foods, proving that the new method can identify allergens from different food matrices.

Table 1

Food Sample	Labeled Allergens	Detected Allergens (by LC–MS/MS)
Bread	Wheat	Wheat (HMW and LMW glutenin detected), milk (beta-lactoglobulin)
Cookie	No label info provided	Wheat, milk, eggs (ovalbumin, ovotransferrin), peanuts, soybeans
Fried Fish	Cod, wheat, milk	Cod (beta-parvalbumin), wheat, milk, eggs
Frozen Pasta	Wheat, milk, eggs, shrimp, soybeans, peanuts	Wheat (mostly durum wheat), shrimp (tropomyosin, myosin light chain, CBP), milk, eggs, soybeans NOT detected despite being listed (likely due to use of refined oil)

This ability to check for multiple allergens within a single run is particularly important for PBM producers. They need to be able to quickly and easily check for multiple allergens from multiple sources, because when developing recipes for these alternative meats, they need to combine ingredients from many different bases to achieve the desired results in taste and in smell. If something in the mix is not working right, they need to know quickly so they can adjust the recipe.

The complete method was extended from frozen pasta, which was initially analyzed, to three further matrices: Bread, cookies (peanut cookies) and fried fish ("beer butter cod") whereas further allergens were detected (Table 1).

Analytical instrumentation is also used to test composition, nutritional content and overall quality. Instrumental analysis reveals important information about the product, such as its protein content, fat content and the presence of any harmful substances. Manufacturers use these tests to ensure that their PBMs meet the desired nutritional profile and are safe for consumption. By combining these tests with others, such as sensory testing, manufacturers can look forward to a very appetizing future for their plant-based meats.

Making progress safe – and palatable

Sensory and allergen testing are just two of the many strategies being used to help expand the acceptance of plant-based alternative foods. Greater acceptance offers benefits ranging from the personal to the global level, as well as financial benefits for the companies able to meet the increasing consumer demand. Shimadzu instruments deliver the capability to fast and efficiently perform most of the necessary tests for this growing industry. We know there is a hunger and no time to waste.

Planet Earth – and humanity – will face a number of challenges in the coming years. Many say that we are already facing them today. However you look at it, the solution is simple: science. Using the best science and the best technological tools, together we can rise to meet the challenges.

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Predicting fouling to save energy when heating high-protein dairy products



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The Fraunhofer Institute for Process Engineering and Packaging IVV has developed an AI-based monitoring system that detects fouling in heat exchangers at an early stage. This system significantly reduces downtime and cleaning efforts, particularly for high-protein products.

Challenges in Pasteurizing Protein-Rich Products

Pasteurization and ultra-high-temperature (UHT) treatment of protein-rich dairy products is a particularly resource-intensive process in the food industry. When heating milk, deposits, also known as fouling, primarily occur due to the denaturation and aggregation of milk proteins, fats, and minerals. These deposits significantly reduce process efficiency by impairing heat transfer and flow rate. Through long-standing industrial practice and extensive research, the temperature management during milk heating has been optimized, allowing typical production times of 20 to 24 hours in UHT plants before cleaning is necessary.

The risk of fouling is significantly greater when heating finished products such as milk-based drinks, yogurt drinks, and high-protein products. Due to the growing demand for protein-rich foods, dairies are producing more high-protein products. These products are heated in specialized finished product heaters. The higher protein content promotes faster and more intense deposit formation, which complicates process management. Consequently, potential production times are drastically reduced, and facilities may need to be cleaned again after only a few hours. In addition to the increased demand for water and cleaning agents and the risk of microbial contamination, rising energy consumption and associated costs pose significant challenges for producers.

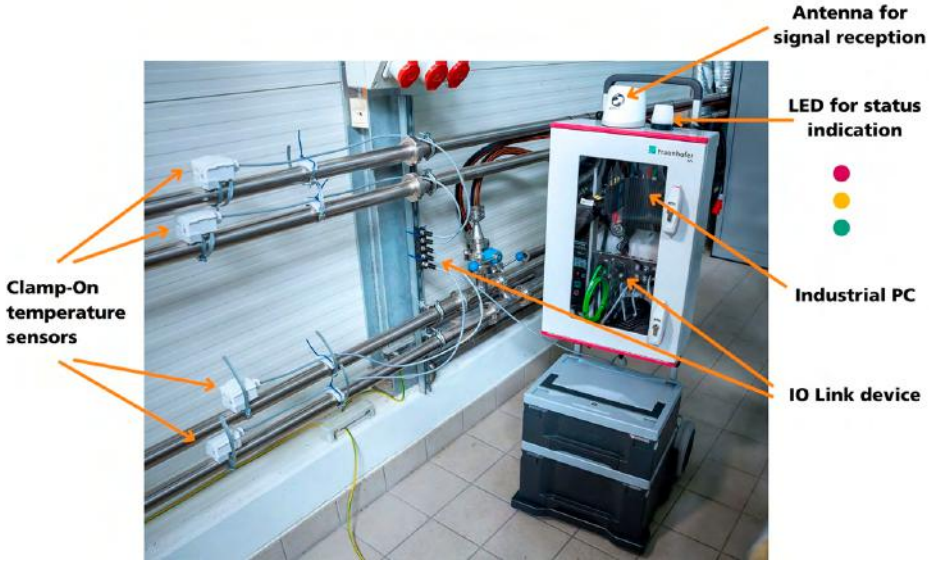

Image 1: Structure of the fouling prediction system

Innovative solutions through predictive fouling detection

To address these challenges, the Fraunhofer Institute for Process Engineering and Packaging IVV has developed a predictive fouling detection system called »CoControl-FouliQ«. The system consists of temperature sensors, a computing unit, and a machine learning model for data analysis and fouling prediction. With »CoControl-FouliQ«, fouling can be predicted during the heating process, enabling demand-oriented planning of heat exchanger cleaning.

An innovative hardware solution has been developed for use in heat exchangers. It is specifically tailored to the challenging production conditions (see Image 1). The solution's central element is a compact, waterproof unit that shields electronic components from external influences and can be cleaned with wet chemicals. An industrial PC ensures

Image 2: Sensor product inlet

Image 3: Sensor product outlet

secure and reliable data processing. Four clamp-on temperature sensors connected via IO-Link measure temperatures at the heat exchanger's inlet and outlet non-invasively and in real time. An AI model calculates the predicted temperature or pressure increase on the steam side of the heat exchanger to compensate for reduced heat transfer. This allows one to forecast whether planned production can be carried out cost-effectively or if additional cleaning is necessary beforehand.

Validation and performance of the model

The practical applicability of the »CoControl-FouliQ« system has been successfully demonstrated during a multi-week testing phase conducted under real operating conditions at a dairy plant (see Images 2 and 3). The results show that the model can accurately predict the hot water entry temperature. Figure 1 illustrates the alignment of the model predictions with the actual measurements and shows that the predictions are reliable for different lengths of input data (180, 240 and 300 data points). With longer data series, the predictions demonstrate particular stability, enabling effective damping of short-term fluctuations – an advantage for quality-critical processes.

Advantages of continuous monitoring

Continuous monitoring of the heating process is crucial for analyzing deposit formation during production. This monitoring enables precise predictions to be made about the behavior of fouling. A significant advantage of this system is that it can be easily integrated into existing plants, allowing for flexible adaptation to established production lines. The collected data provides valuable insights, particularly in ultra-high temperature processing, which is often used for small batches and product changes. This helps to optimize production processes. This is particularly relevant for finished products such as protein-rich milk and yoghurt drinks. Fouling prediction enables more efficient control of heating processes, leading to better planning of the production sequence. Furthermore, this approach significantly reduces cleaning cycles while maintaining high product safety standards.

Conclusion: Efficiency Improvement and Sustainability

With the »CoControl-FouliQ« system, fouling prediction can be applied to all heating processes. In particular, the system helps reduce cleaning cycles and improve product safety for complex, high-protein products in the areas of pasteurization and ultra-high temperature processing. Furthermore, reducing cleaning cycles significantly cuts water, energy, and cleaning chemical usage, significantly improving the sustainability of the production process and lowering costs. Since cleaning is carried out on demand rather than at set intervals, production capacity can increase, and facility availability can be optimized. Using »CoControl-FouliQ« provides a solid foundation for improving efficiency, processes, and resource efficiency while achieving cost savings in food production.

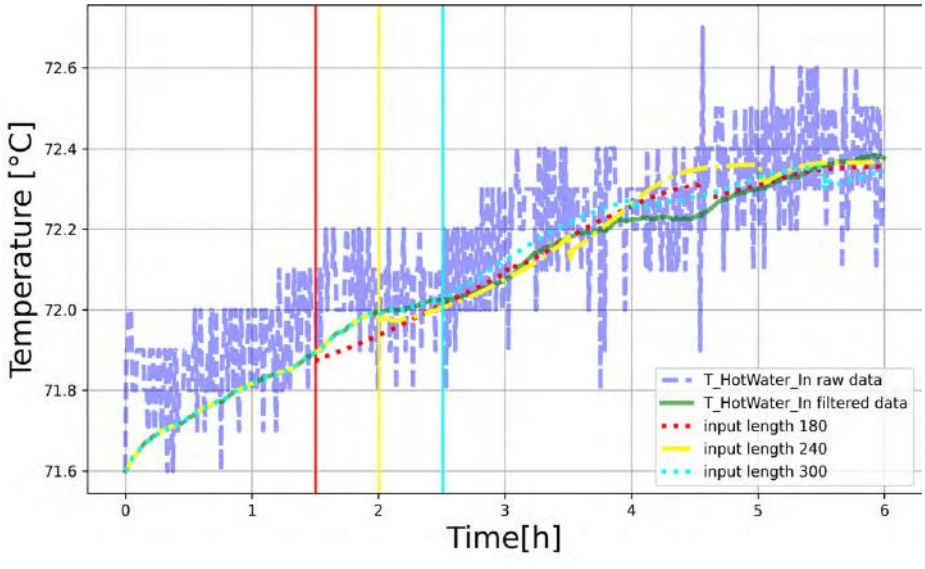

Figure 1 – Prediction of the hot water entry temperature, calculated for different data sets (180, 240, 300 data points)

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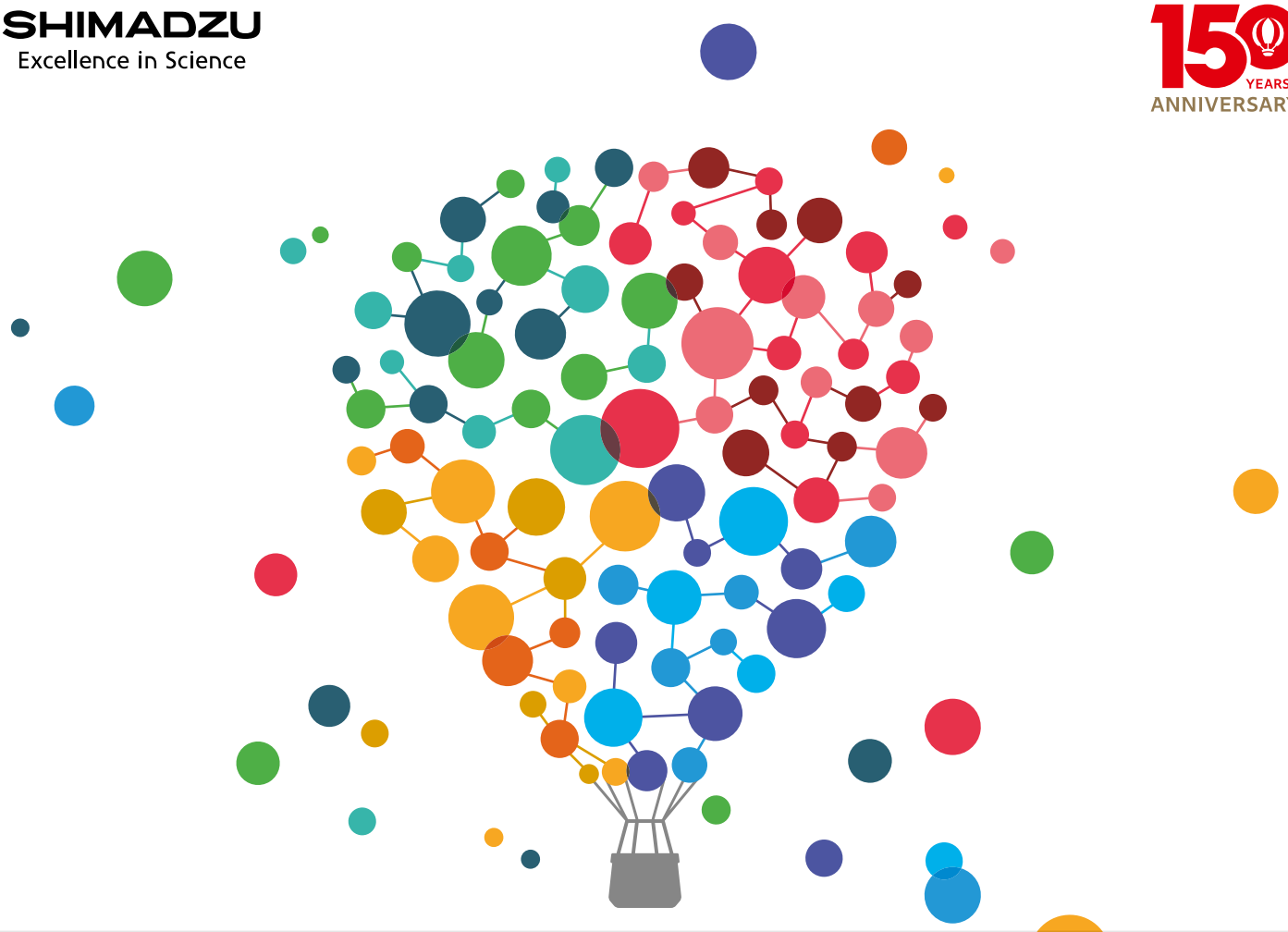

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