

CASE STUDY

Advancing Trace and Nutritional Elements Analysis In Food and Beverages



Campden BRI Uses NexION ICP-MS With Unique EDR Capability

There is a growing demand among global food and drink manufacturers, legislators, and consumers to know the elemental composition of what we eat and drink. Scientists now routinely analyze food and drinks to verify much more than product suitability, safety, and shelf life. Top concerns also include product authenticity, nutritional content, and making certain that foods and drinks fully comply with increasingly strict labeling laws around the world. Beyond the physical properties of food, science is not only determining the chemical, biological, and physical contaminants in what we eat and drink, it is becoming more focused on whether our foods and drinks actually contain the ingredients listed on their labels.

“Product safety is an absolute imperative for food and drink companies,” Julian South, Head of Chemistry and Biochemistry at Campden BRI, says. “In addition to chemical and microbiological analysis, we offer expertise in the investigation of the physical properties of food and drink, identifying any contaminants, authenticity, and verifying that products are what the labels say they are.”

To help its members stay compliant with ever-changing requirements on toxic metal and nutrient content in foods and beverages, Campden BRI made a major investment in 2015 in new ICP-MS instrumentation, selecting PerkinElmer’s NexION® ICP-MS over its rivals.



Figure 1. The NexION system in use at Campden BRI.

Since the acceptable limits of adulterants and contaminants in food and drinks have been pushed constantly towards ever-smaller amounts, Campden BRI needed, prior to acquiring the NexION, to run high- and low-level quantification of food samples separately. This meant preparing the samples at two different dilutions; a small dilution to analyze for the low level contaminants and a high dilution to analyze for the nutrients that exist at very high levels in the samples. In addition to having to perform two analyses, using a traditional ICP-MS to run food and drink samples at small dilution may cause deposits from dissolved solids to build up on the instrument’s interface cones and on its ion optics. Over time, those deposits can jeopardize the instrument’s results, ion transmission stability, and even its life span. “They also lead to costly cleanups between sample runs and instrument downtime”, South says.

Extended Dynamic Range (EDR) Changes Everything

The NexION’s three tandem quadrupoles significantly extend (not shift) the instrument’s ultratrace detection limits. The “power” of the design comes from the ability to use the second quadrupole as an ion guide, a collision/reaction cell, or both. As an ion guide, the transmission of ions through the quadrupole can be adjusted ‘on the fly’ and on a per isotope basis. As such, when looking at low level elements, the ion transmission can be kept at maximum, but when acquiring data for high-level elements, the ion transmission can be attenuated to permit accurate measurement of the signal. That allows Campden BRI scientists to characterize and quantify both low-level, food safety contaminants, such as lead (Pb), arsenic (As), cadmium (Cd), and mercury (Hg), and macro-level nutritional elements, including calcium (Ca), magnesium (Mg), potassium (K), and sodium (Na), simultaneously.

CAMPDEN BRI

Located in the historic English town of Chipping Campden, Gloucestershire, UK, Campden BRI is the world’s largest member-based food research organization. With more than 2,400 companies, research organizations, government and consumer agencies, and academic institutions in nearly 80 countries among its members, Campden BRI’s research priorities truly reflect a global scale. Three areas that regularly top Campden BRI’s research list are food safety, authenticity, and nutritional value.

CAMPDEN BRI FAST FACTS

Founded:

1919

Number of employees:

Approximately 400 located in the UK and Hungary.

Expertise:

Specializes in practical application of technical excellence to support the food and allied industries through analysis and testing, operational support, research and innovation, and knowledge management.

History

1919

Fruit and Vegetable Preserving Research Station opens in Chipping Campden, in Gloucestershire, England, in 1919 as an affiliate of Bristol University’s agricultural and horticultural research department.

1920s

Creates the solution that led to the Campden Tablet that prevents fruit spoilage and remains popular in wine, cider, and beer making to kill bacteria and to inhibit the growth of most wild yeast.

1940s

Campden research facility spun off as a non-profit food research association catering to the global food and beverage industry.

1995

Campden merges with Flour Milling and Baking Research Association, which added milling and baking expertise to the mix of what now became the Campden & Chorleywood Food Research Association, or CCFRA.

2008

CCFRA and Brewing Research International (BRI), a similar non-profit membership association specializing in beer and wine, join forces to create Campden BRI, the largest membership-based food and beverage research organization in the world.

2015

Receives United Kingdom Accreditation Service (UKAS) for its upgraded metals analysis service. In November opens Consumer Food and Drink Test Center to complement its existing sensory and consumer facilities at its headquarters in Gloucestershire, and at the site of its brewing division in Nutfield, Surrey.

"The NexION has enabled us to provide a fast and accurate service for elemental analysis for our member food companies," South says. "The ability to remove interferences and the wide dynamic range has ensured we can cover all elements in all matrices. These are particularly challenging in some types of food samples so the backup from the PerkinElmer team has been very helpful."

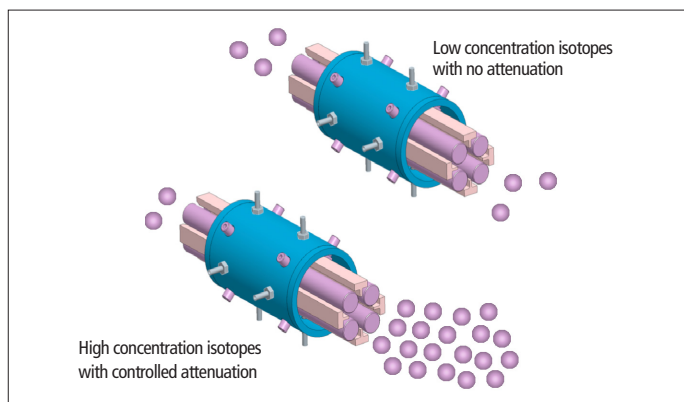


Figure 2. Extended Dynamic Range (EDR) controls the number of ions passing through the Universal Cell on an isotope by isotope basis. In this figure the purple spheres are the isotope of interest. EDR means that low concentration isotopes can pass with no attenuation and high concentration isotopes can pass with controlled attenuation (adjusted to 10x in this example). The benefits to the user are that only one ICP-MS method needs to be used, samples don't need to be diluted and the detector lasts longer.

South also says PerkinElmer's NexION additionally helped Campden BRI to earn UKAS accreditation for its upgraded metals analysis service.

Dr David Bellis, ICP-MS specialist at Campden BRI, adds that an additional benefit of the NexION's wide range is its ability to attenuate the higher concentration elements that allows the instrument's detector to see fewer ions, which extends its life.

Revolutionary Design

In addition to EDR, what puts the NexION ICP-MS in a class by itself are its unique triple cone interface, quadrupole ion deflector design, and Syngistix™ software. The triple cone interface offers the industry's most tightly focused ion beam and prevents sample deposition on internal components, which improves stability and eliminates the need for additional analytical runs and sample dilutions.

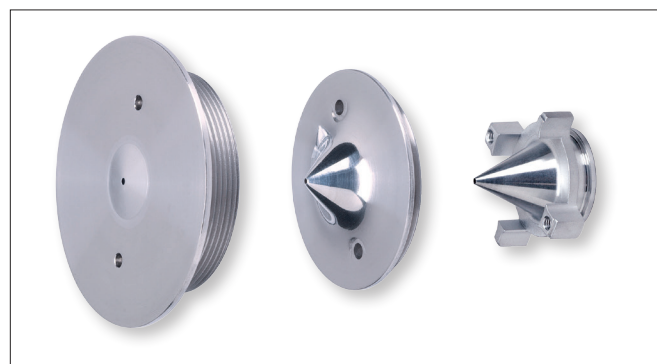


Figure 4. Unique Triple Cone Interface delivers both sensitivity AND stability. Easily accessible, the interface is the only component that requires cleaning so instrument maintenance is faster and simpler compared to other systems.

The quadrupole ion deflector, meanwhile, is a unique disruptive technology that turns positively charged ions 90° before they enter the patented Universal Cell and analyzing quadrupole to reduce background and interferences for more accurate results. The quadrupole ion deflector is the only filter of its kind to allow mass bandpass adjustments on the fly, automatically, to maximize sensitivity for every element in a run. Because it is precisely aligned with the triple cone interface, ions and neutrals never impact the component's surfaces, keeping it clean for exceptional signal stability even when running the most challenging matrices. In fact, the instrument is so effective at removing unionized material, it is the only ICP-MS with a cell that never needs user maintenance or replacement.

Add in PerkinElmer's Syngistix™ for ICP-MS software and Campden BRI scientists are doing more of what they love – science. Developed especially for the NexION, Syngistix features an easy-to-use, intuitive interface, along with new automated method setup tools for faster implementation. Its user-defined and customizable reporting capabilities facilitate support for a variety of peripherals, including online auto-dilution systems, ion chromatography, gas chromatography and laser ablation.

Expanding Campden BRI's Capabilities

"There is no question that the NexION has increased our operational efficiency," Julian South says. "Its ability to run two samples at once on a single instrument has increased

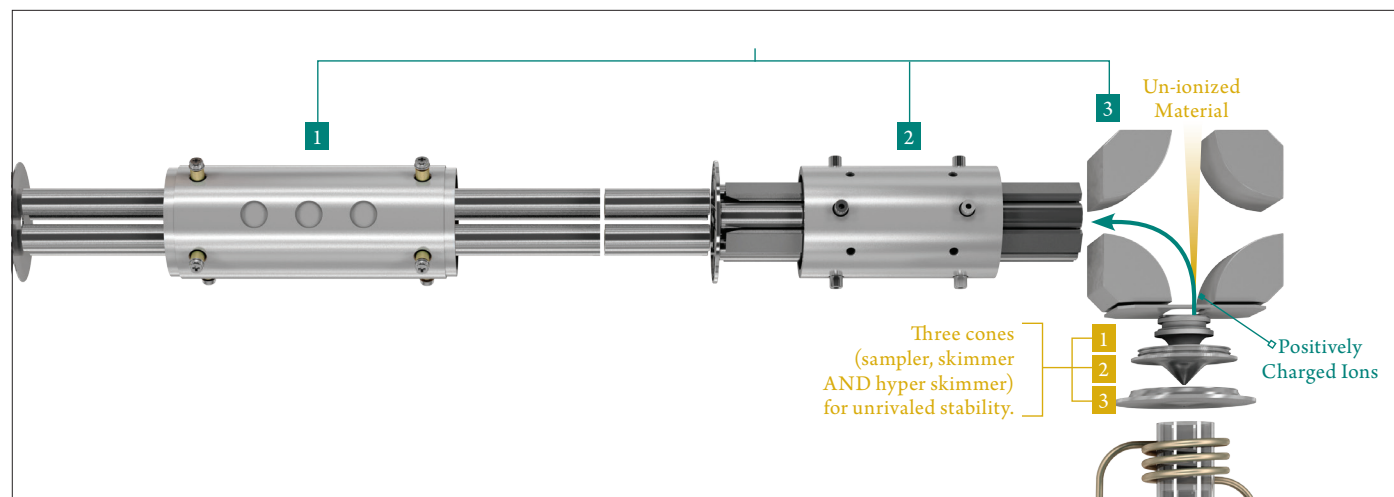


Figure 3. Three quadrupoles to maximize sensitivity for every element in a run. Quadrupole Ion Deflector filters off neutrals for greater stability and consistency.

the laboratory's productivity, lowered our costs, and increased our field of operations to include accredited heavy metals analysis that will help food companies ensure that their products meet the regulatory requirements of the countries in which they sell."

Another growing area of expertise for Campden BRI and its use of the NexION is food and beverage authenticity. Using a multi-element suite for detection purposes, Campden BRI scientists are leveraging the instrument's unique capabilities to help fingerprint foods and beverages to verify their place of origin and authenticity. "We already have a huge amount of reference data on cereals, and we expect that will only grow, thanks to the NexION," South says.

"The authenticity project is just getting underway," Bellis says. Noting that food fingerprinting is expected to emerge rapidly due to government pressure on the industry to develop robust methods around product traceability. As that process unfolds, Campden BRI has the expertise and the right analytical instrumentation to ensure that the world's food supply remains both genuine and safe.

Looking ahead, South is quick to point out that Campden BRI is known for its proactive stance on adopting new processes, equipment, and developing technical collaborations that the company positions as a global center of excellence for the food and drink industry. "We hope to expand our relationship into the critically important areas of next-generation sequencing and traceability of ingredients and raw materials, and we are looking to expand our work in food and non-food forensics," he says. "As the scope of regulation continues to broaden and demands more support from analytical technology, we see a lot of shared value in working together with PerkinElmer for the benefit of both organizations."

PerkinElmer, Inc.
940 Winter Street
Waltham, MA 02451 USA
P: (800) 762-4000 or
(+1) 203-925-4602
www.perkinelmer.com



For a complete listing of our global offices, visit www.perkinelmer.com/ContactUs

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