



Center of Toxicology of Quebec Chooses PerkinElmer's NexION 300 ICP-MS for the High-Throughput Analysis of Complex Samples

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The Center of Toxicology of Quebec (CTQ) is a well-respected branch of the National Public Health Institute of Quebec (INSPQ) in Canada, a government body created to improve the health and well-being of people who live in Quebec and to support regional public health authorities and social services institutions by offering expertise in specialized laboratory and screening services.

In 1972, the CTQ laboratory in particular was commissioned by the Quebec government for the detection of toxicants in the human population related to drugs of abuse, exposure to organic pollutants and the impact of heavy metals. This highly prestigious laboratory is accredited under ISO 17025 and 17043 by the Standards Council of Canada, and since 1979, has operated several external quality assessment and proficiency testing schemes related to metals in human biological specimens including:

- Interlaboratory Comparison Program for Metals in Biological Matrices (PCI), which enables participating laboratories to assess the accuracy of their analytical results for up to twelve trace metals, using biological samples that are not freeze-dried. Currently 121 laboratories in thirty different countries worldwide participate in this program.
- Quebec Multielement External Quality Assessment Scheme (QMEQAS), which was initiated in 1996 to supply laboratories having multielement capabilities, such as ICP-MS, with a wide range of analytes in human biological samples that are not freeze-dried. Currently 63 laboratories are involved in this program.

The CTQ laboratory has been a very loyal PerkinElmer customer, having purchased three ELAN® ICP-MS systems over the past 20 years (ELAN 5000, 6000 and DRC II). However, due to higher workloads and growing sample throughput requirements, they decided to expand their ICP-MS testing capability in early 2011. And even though they had a very positive experience with ELAN ICP-MS systems, they approached the evaluation with an open mind and were fully prepared to purchase the best instrument to handle the high-throughput demands of running complex biological samples – up to 16 hours a day and 5 days a week – not only in the context of clinical and occupational exposure assessment studies, but also to acquire the best instrument for demanding biomonitoring investigations, where the quality requirements are more critical.

For these reasons, they thoroughly evaluated all available commercial instrumentation, including PerkinElmer's NexION® 300 ICP-MS, by analyzing four different biological matrices – whole blood, serum, urine and dialysate – using the following performance criteria:

Performance Criteria	
Criteria	Evaluation Test
Sensitivity	Expressed as the detection limit (DL) Calculated as the 3 σ standard deviation of 5 replicates of a low-level QC standard
Short-term reproducibility	Relative standard deviation (RSD) of 10 replicates of a QC sample
Long-term stability	Precision and drift obtained by running the instrument over 4 hours
Accuracy	Based on CTQ's own proficiency material reference values
Matrix effects	Matrix suppression produced by various matrices
Memory effects	Time taken for various matrices to be flushed through the sample introduction system

So, we were extremely happy when the CTQ decided in favor of PerkinElmer's NexION technology.

When we designed the NexION 300 ICP-MS, one of our main objectives was not only to develop a next-generation high-performance ICP mass spectrometer, but also an instrument that offered a high degree of flexibility and was very easy to use. Dynamic Reaction Cell™ (DRC) technology was undoubtedly recognized as being the most comprehensive approach to removing matrix- and plasma-induced polyatomic interferences in difficult samples. However, we realized that not every application needed that level of performance or interference-reduction capability – some laboratories were

not analyzing complex sample matrices, while others did not require extremely low detection limits. Additionally, many analytes could be determined relatively easily by ICP-MS, either by using traditional approaches such as cool/cold plasma or simple collision cell technology to reduce the interferences.

As a result, the NexION 300, using Universal Cell Technology™, offers 3 modes of operation (Standard, Collision and Reaction) that can be quickly switched from one to another, depending on the spectral complexity of the analytes being determined. CTQ chose the NexION 300S, which is the dual-channel version optimized for high sensitivity.

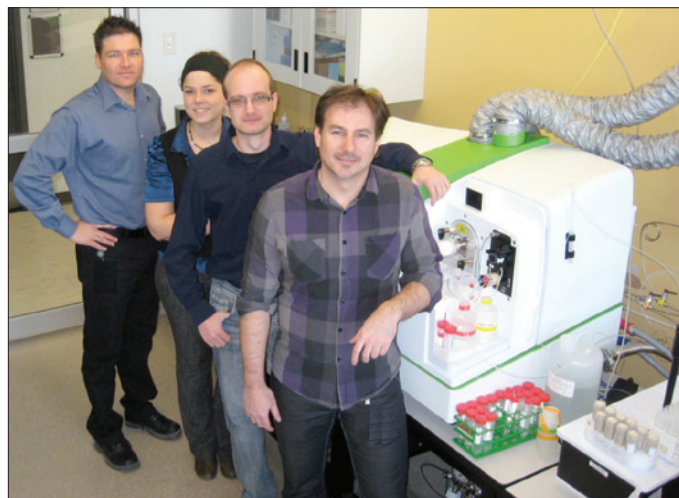


Figure 1. INSPQ's NexION team (from the front/right): Pierre Dumas – Senior R&D Chemist; Ciprian-Mihai Cirtiu – R&D Chemist; Claudine Roussy – Technologist; Patrick Bélanger – Metal Division Coordinator.

As Pierre Dumas, CTQ's Senior R&D Chemist and an expert in trace metals' method development, put it:

“For our application, it was critical that the new instrument could achieve equal or superior performance to our current ICP-MS system, so as a comparison, every evaluation experiment was also carried out on our ELAN DRC II.”

He went on to say: *“After an exhaustive evaluation process, we were very excited that the NexION 300S was very impressive in all of the performance categories. But the area that set it apart from the others, including the ELAN DRC II, was the incredible sensitivity achieved for elements like chromium and vanadium, which are prone to severe polyatomic interferences in biological matrices.”*

We knew that the sensitivity specification of the NexION was approximately 2-3 times higher than that of the ELAN DRC II, and the background about 5 times lower, but it was very encouraging for us that this increase was achievable in notoriously difficult matrices, like biological fluids.

CTQ's NexION 300S ICP-MS was installed in April 2011. It took less than a week to carry out the installation by PerkinElmer's regional service engineer, Brian Clappison, including two additional days of training by Chady Stephan, our application chemist based in Toronto, who helped them set up the trace metals screening methods for blood and urine. However, they had to wait a couple of additional weeks to complete the validation process before routine samples could be analyzed.

Routine analysis for the CTQ lab includes up to 30 trace metal analytes in a variety of biological matrices, including whole blood, serum, urine, human hair, tissue digests, dialysate and atmospheric dust samples. The instrument currently runs about 12 hours a day, analyzing between 50 and 100 samples a day. So there is no question that over the past nine months, the instrument has been really put through its paces – something that Pierre wanted to emphasize when he commented:

“As a reference laboratory where high performance, sensitivity and accuracy must be achieved every day, there is no doubt in my mind that the NexION has proven itself to be the best instrument available for our application. It offers all the benefits of the ELAN DRC II, but with more stability and sensitivity...plus the opportunity to use KED correction mode, if we should need it.”

This last point is actually quite significant, because this has given PerkinElmer and CTQ the opportunity to work together to compare both Reaction (DRC) and Collision (KED) correction modes for real biological reference materials. In fact, this collaborative project is on-going with the investigation being

carried out by both Chady Stephan of PerkinElmer and CTQ application chemists. We are very optimistic that the data will be published in an upcoming application note or journal article.

But no performance evaluation process can really test out the instrument's suitability for running real-world samples on a truly high-throughput routine basis – which is summed up by Pierre:

“We really appreciate the fact that the instrument requires less maintenance than our ELAN DRC II, as well as being very easy to optimize and operate. We are totally satisfied with the instrument and without hesitation could recommend it to other users in our application field.”

It is well-accepted that there are very few applications more demanding for an ICP mass spectrometer than running complex biological fluids. So, we are very proud of the fact that the NexION 300S ICP-MS installed at INSPQ's Center of Toxicology of Quebec has not only met our design objectives but also confirmed our expectations in coping with the demands of a high-throughput toxicological laboratory.

We'd like to leave you with one last thought from Pierre:

“It is critical for us, as a leading reference lab in the field of toxicology, to achieve the best possible accuracy. I believe that complete elimination of polyatomic spectral interferences by reaction chemistry is essential to achieve this goal.”

Thank you Pierre for the kind words and we look forward to continuing our long-standing relationship.