SUSTAINABLE MYCOTOXIN TESTING

The Economic, Environmental, and Social Benefits of Multi-analyte Methods

As the demand for productivity growth and the reality of limited resources have converged, sustainability has become the watchword of forward-looking organizations. In its broadest sense, sustainability refers to the capacity of resources, systems, and processes to endure over the long term. To qualify as sustainable, the processes that drive analytical laboratories must meet the needs of the present without jeopardizing the organization's long-term productivity or the success and well-being of future generations. To that end, analytical processes must be economically sound as well as environmentally friendly and socially responsible. That's a tall order, especially in the realm of mycotoxin analysis.

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THE EVOLUTION OF MYCOTOXIN TESTING REQUIREMENTS

One of the keys to sustainability is the ability to adapt to changing expectations and requirements. Since 1969, when the U.S. Food and Drug Administration (FDA) set its first mycotoxin action level of 20 ppb for aflatoxins, three trends in mycotoxin regulations have raised the bar for food safety testing:

- Expanding global reach: As of 2013, more than 100 countries had regulations or official guidelines for mycotoxin control in food and feed.[1]
- Growing breadth: By 2003, regulations in various countries spanned more than 16 mycotoxins or groups of mycotoxins.[2]
- Increasing stringency: Limits as low as 0.25 ppb for aflatoxin M1 in infant formula are currently in force in the European Union (EU).[3]

These trends, together with heightened public concern about food safety, have fueled the demand for fast, accurate, and highly sensitive determination of an increasingly diverse array of mycotoxins. Corn growers, for instance, may now require analytical data on five or more mycotoxins in addition to aflatoxins to gauge the safety, quality, and marketability of each lot. Peanuts, coffee, wine, tree nuts, and other commodities that may harbor a mixture of mycotoxins also undergo extensive screening as they travel across the global supply chain. Upstream and downstream businesses increasingly rely on comprehensive toxin profiles to not only demonstrate compliance but also reassure their customers. For food processing companies, these data also serve as a window into their production processes and their far-flung suppliers' performance.

Most important, this more rigorous approach to testing is a linchpin in the food industry's efforts to reduce the risk of mycotoxin-associated diseases and limit the financial impact of contamination. With more knowledge about a lot's mycotoxin content, suppliers and processors are better equipped to control their spread and keep contaminated ingredients out of feed and food products. Detailed information about contamination levels also helps protect merchants and traders from the disastrous consequences of putting unsafe products on the market.

The wisdom of this risk reduction strategy is becoming increasingly apparent as more data on mycotoxin mixtures comes to light. Animal studies and in vitro experiments suggest that interactions between different types of mycotoxins that occur together can compound their toxic effects.[4,5] In cases where various mycotoxins interact synergistically, the boost in toxicity can be particularly dramatic, resulting in health damage or livestock performance declines that far exceed the sum of the negative effects from each toxin.[4] Research also indicates that mycotoxin mixtures are particularly common in grains and animal feed and can accumulate in animal products such as meat, milk, and eggs.[6] International regulatory agencies are currently assessing the public health implications of these findings to determine whether tighter mycotoxin limits are warranted.

Viewed within the context of this burgeoning risk landscape, test methods designed to confirm a single toxic threat loom as obstacles to sustainability. When six or seven mycotoxins are in question, methods that require a separate test run for each target analyte create a sinkhole of inefficiencies. Over the long term, this approach is likely to devour enormous amounts of time, manpower, and laboratory consumables. Ultimately, it's bound to prove as unfit for the unfolding regulatory scene as it is for an economic climate and a natural environment that call for doing more with less.

THE CASE FOR MULTI-ANALYTE MYCOTOXIN TESTING

These challenges are driving the evolution of mycotoxin diagnostics from single- to multi-analyte methods. A mycotoxin testing process that rests on a solid representative of these next-generation methods hits the mark in all three areas of sustainability.

Economic feasibility: To sustain the economic viability of their services, analytical laboratories must manage their resources with an eye toward eliminating waste. Simultaneous determination of multiple analytes conserves time, materials, and human effort. These savings translate into a streamlined testing process that allows for higher throughput at a lower cost. As these efficiency gains enable laboratories to provide faster turnaround times and lower prices, the food industry's productivity and profitability also stand to improve.

Environmental impact: Multi-analyte mycotoxin testing cuts down on hazardous waste, such as mycotoxin extracts, flammable and potentially toxic organic solvents, and other environmentally harmful chemicals. This approach also reduces the need to replace plastic labware and other nondurable supplies that consume energy and release greenhouse gases during their manufacture.

Societal relevance: Laboratories can advance important social aims by shifting to a leaner, greener analytical process that closely aligns with emerging food industry priorities. This optimized process promises to enhance both the quality of life for people who work in the laboratory and agri-food sectors and the well-being of society as a whole. The potential benefits include:

- Improved human and animal health
- Reduced healthcare costs
- A safer and more abundant food supply
- Lower risk to livelihoods of growers, processors, and traders from mycotoxin-related losses
- Stronger economic growth from increased agricultural and trade revenues
- Increased potential to hire and retain laboratory and food industry staff
- Safer workplaces and communities
- Tighter management of the global supply stream

A SUSTAINABLE SOLUTION FROM VICAM®

VICAM's Myco6in1+® LC-MS/MS column adds the sustainability gains derived from multi-analyte mycotoxin testing to the proven performance advantages of advanced immunoaffinity technology.

Optimized for use with LC-MS/MS, this powerful instrumental method accurately detects and quantifies trace levels of six of the most toxicologically significant categories of mycotoxins in a single run. Analysts can also obtain fast, sensitive, reliable results by combining immunoaffinity column cleanup with HPLC with PDA, fluorescence detector, and post-column derivatization or Waters' ACQUITY UPLC® System with ACQUITY® QDa® Detector (a mass detector).

All-in-One Sample Cleanup

Monoclonal antibodies in the columns selectively bind to target analytes, yielding high concentrations of 12 different mycotoxins, including aflatoxins, ochratoxin A, fumonisins, deoxynivalenol, zearalenone, T-2 and HT-2 toxins, and nivalenol. Sample cleanup is simple, rapid, and thorough. No additional steps are required to remove matrix impurities.

Confident Confirmation with a Single Analysis

The high signal-to noise ratio achieved with this method contributes to precise, reproducible measurements at or below the limits of detection required for compliance with strict EU regulations. Designed to meet the European Committee for Standardization (CEN) standards, multi-analyte testing with Myo6in1+ delivers analytical data with the ruggedness and credibility demanded for trade purposes, risk assessments, and increased confidence in the safety and quality of food and feed.

Measurable Process Improvements

Myco6in1+ instrumental methods significantly reduce the cost, manpower demands, time-to-results, and environmental footprint of the testing process. (See Table 1.)

Table 1. Process improvements (% savings) achieved by using Myco6in1+ instead of single-analyte tests to determine six classes of mycotoxins*

Benefit	Savings
Shorter time-to-results	50%
Reduced hands-on time	83%
Decreased spending on purchase and disposal of organic solvents	50%
Less hazardous waste	50%

**Savings percentages listed are average values observed and may vary from laboratory to laboratory.*

These savings enable analytical laboratories to respond to the rising pressure for faster, more affordable mycotoxin testing and greater productivity without increasing their environmental impact or compromising the quality of their data. The result is a mycotoxin testing process of enduring value to analytical laboratories, their end users, and the larger world.

References

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