TOXIMet



Advanced, globally proven mycotoxin testing system

enhancing food safety from producer to consumer

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Introduction

ToxiMet successfully launched its revolutionary new system for the measurement of mycotoxins in food and feed in 2012.

ToxiQuant instruments are now a key component in commodity testing at customer sites across five **continents.**

The ToxiMet System can be used by non-scientists and provides the accuracy of high-end instruments, such as HPLC but at a fraction of the cost and time.

Food producers, traders and processors can now comply with the highest food safety standards while rotating their stock much faster and reducing their testing and storage costs.



Abstract

Proper control of food safety is a major issue globally. An exponential increase in food exports over the last 40 years and tightening regulations around the world drives the demand for food safety testing methods.

As the route to market has become more complex, testing protocols are required that can be used at any point in the global supply chain.

ToxiMet has developed a platform technology that can be used by non-scientists and can be applied to the analysis of many substances associated with food safety and quality. The first application is the accurate measurement of mycotoxins.

The mycotoxin problem

Mycotoxins are chemicals produced by fungi. **The FAO estimates that 25% of global crops are contaminated with fungi that may produce mycotoxins.**

Other sources estimate that 5-10% of all commodities traded globally are contaminated by mycotoxins and need to be discarded. The incidence of contamination varies each year depending on agroclimatic conditions and over the last ten years, **mycotoxins consistently accounted for 30-60% of food and feed rejections at European Union borders.** Mycotoxin contamination is ten times more frequent than any other cause for rejection.

Some years are especially devastating. For example, **USGC (United States Grain Council) research found that 14.1% of corn samples from the 2012 crop contained aflatoxin levels above those permitted by US food safety regulations.**

There are huge commercial losses associated with the improper and delayed detection of contamination.

Even more important, deficient controls can lead to contaminated food being consumed by humans, with deadly consequences: for example, **125 people died of acute mycotoxin intoxication in Kenya in 2004.**

Some mycotoxins have been proven to produce cancer, so long term exposure is a major health issue. Regulations therefore require that mycotoxin concentration in food and feed is kept to very low levels.

Mycotoxins are potent toxins that are produced by certain fungi and can contaminate numerous commodities

Fungi	Mycotoxins
Aspergillus favus *A. parasiticus*	Aflatoxins B_1, B_2, G_1, G_2
A. ochraceus *Penicillium verrucosum*	Ochratoxin A
Fusarium graminearum	Deoxynivalenol (Trichothecene)
F. graminearum	Zearalenone
F. verticillioides	Fumonisin B_1
Penicillium expansum	Patulin

Food commodities affected

Peanuts	Raisins
Pistachio nuts	Currants
Brazil nuts	Sultanas
Almonds	Figs
Hazelnuts	Fruit
Cashews	Fruit Juice
Corn	Coffee
Wheat	Milk
Oats	Wine
Barley	Beer
Rice	Spices
Sorghum	e.g. black pepper, nutmeg, chilli

The food supply chain

Given that fungi produce the toxins, contamination can arise in the field or at any point during the long transit of commodities from the farm to the consumer.

For example, it is possible that no contamination is detected before the consignment is shipped but after spending sometime in transit, fungi grow and the load becomes contaminated. **Therefore, testing must be done at all points along the supply chain.**

With current testing methodologies, users have to compromise, choosing either speed and low cost or accuracy and high price.

Techniques that offer a relatively fast and cost effective test, suffer from a lack of accuracy and can only measure single toxins. They produce many false positives and are not able to provide accurate results at the low limits of detection required by stringent regulations, such as those in force in the EU.

Accurate methods, such as High Performance Liquid Chromatography (HPLC), that can provide results compliant with regulations are unfortunately very costly and require highly experienced technicians to run and interpret the tests.

Testing must be done at each handover, with current technology either not accurate enough or too expensive

Testing points within the food chain



Current testing technology in relation to speed, accuracy and cost



Consistent global testing

It is frequently the case that different testing methods are used across the supply chain, even within the same global organisation.

This leads to a lack of consistency in the results and makes the central control and logging of safety information a very difficult task for the global QC team.

Many global companies employ fast, cheap and inaccurate testing methods at the intake of their factories, simply because they do not have the personnel or the time required to use more precise technologies.

Given the low-level of testing by suppliers in origin countries, often in emerging markets, the risk of introducing mycotoxin contaminated material is increased.

Diversity of testing methods compromises global control of the supply chain



Comparison of techniques

All these issues led ToxiMet to develop a totally new testing platform, which can be used by non-scientists and can be deployed at every point in the supply chain.

The ToxiMet System combines the best properties of currently available technologies. It is very fast and cost efficient, and at the same time is able to provide accurate and precise results, with detection levels well below those required by the most stringent regulations.

Additionally, the system has been designed based on the feedback from global food processors, and thus incorporates their requirements.

Results are reported in electronic format, compatible with global LIMS systems, so every batch can be properly logged and tracked.

Testing protocols and results are consistent across all sites and at every point in the supply chain.

The system avoids the need for calibrations that use toxins and is therefore much safer to operate for employees. It is also much more convenient and less prone to error.

Solvent use is drastically reduced in comparison with HPLC, ensuring an environmentally friendly operation and low solvent disposal costs.

The ToxiMet System is a disruptive technology combining the best properties of current testing solutions

Lateral Flow | Fluorometer | ELISA

- \+ Fast results
- – Single toxin
- – Low accuracy

HPLC | UPLC | LCMS/MS

- \+ Accurate results
- \+ Multiple toxins, simultaneously
- – Expensive
- – Complex
- – High maintenance



TOXIQuant

- \+ Fast (results in minutes)
- \+ Highly accurate
- \+ Multiple toxins, simultaneously
- \+ Affordable
- \+ User-friendly
- \+ Minimal maintenance
- \+ No calibration



TOXISep
Clean-up cartidge



TOXITrace
Measurement cartidge



TOXIQuant
Measurement instrument

The ToxiMet solution

The ToxiMet solution is comprised of three core components designed to maximise ease of use and minimise cost.

The ToxiSep cartridge cleans-up the sample extracted from the raw commodity.

The cleaned up sample is then loaded onto a ToxiTrace cartridge, which is inserted for measurement into the ToxiQuant instrument.

- **Designed to be used by non-scientists at any point in the food supply chain**
- **Engineered to drastically reduce cost and increase speed of testing**
- **Initial application: simultaneous & acurate measurement of all aflatoxins (B_1, B_2, G_1, G_2)**

Ease of use

The instrument has been designed to be used by non-scientists across the world. Special emphasis has been placed on making the user interface very intuitive.

We designed a touch-sensitive screen with easily recognisable symbols. This limits the need for text and provides step-by-step, on-screen instructions.

The results are displayed immediately on the screen, without the need for any further calculation.

If required, they are automatically transferred to a laptop for transfer into LIMS or to be communicated in electronic format.

The ToxiQuant user interface has been designed for easy operation by non-scientists, with no need for data manipulation



Comparison with HPLC

The ToxiMet System can accurately, precisely, simply, rapidly and affordably measure the level of aflatoxins (individual and total) in edible nuts, dried fruit, rice and corn.

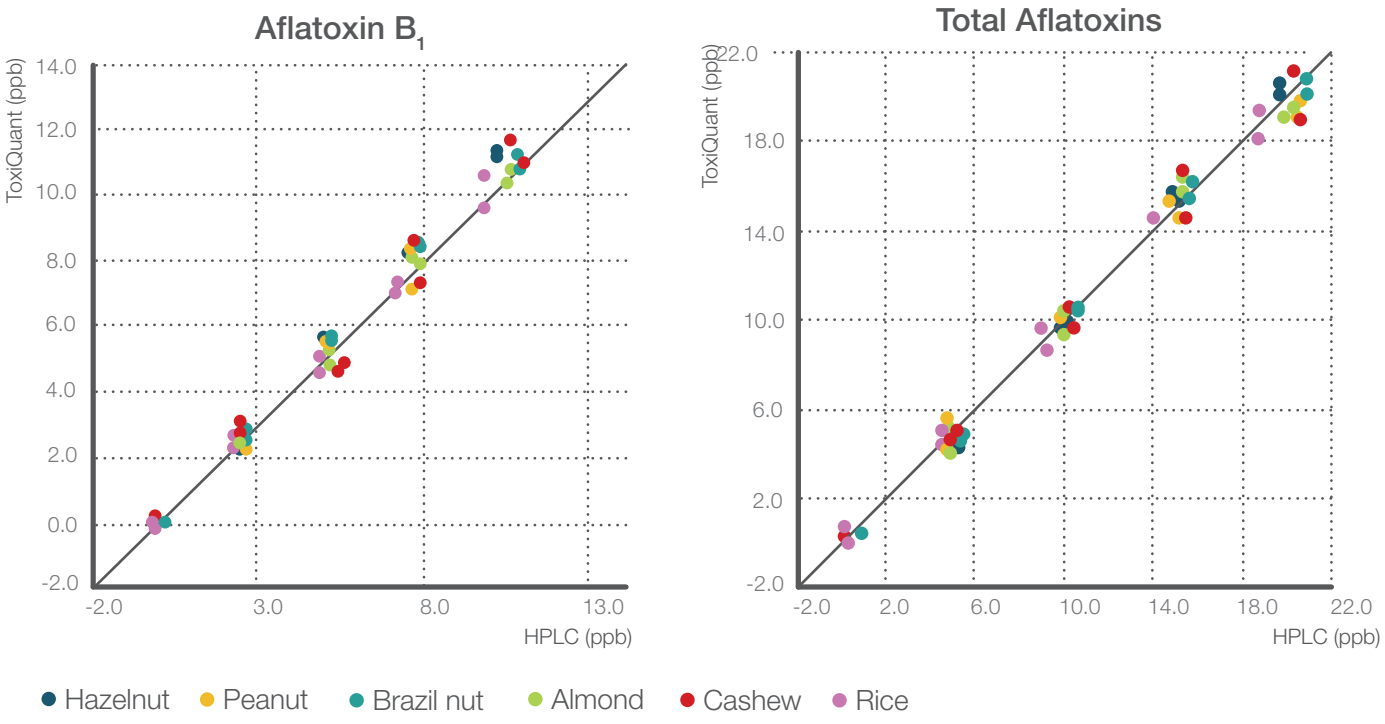
It can perform analysis at EU regulatory levels to 'sub parts per billion' accuracy. The results are available in minutes rather than hours (or even days if contracting out) with some current methodologies and testing can take place outside the normal laboratory environment.

The ToxiQuant generates quantitative results that are in excellent agreement with HPLC data while achieving a 70% saving in the cost of operation.

The figure below graphically compares the results, obtained using the ToxiQuant and HPLC, from five nut samples (hazelnut, peanut, Brazil nut, almond, and cashew) and a rice sample.

The samples were analysed in duplicate spiked at five different concentrations; and the results show the individual aflatoxin B_1 and total aflatoxin levels (sum of B_1, B_2, G_1 and G_2) in parts per billion (µg/kg).

ToxiQuant vs HPLC: highly accurate results when used to measure aflatoxins in a variety of foods, in excellent agreement with HPLC



- **A mixture of all four aflatoxins was spiked onto individual ToxiTraces and also analysed by HPLC**
- **Duplicate ToxiTraces prepared for each commodity, at each of five toxin concentrations (inc. zero)**
- **Excellent agreement between ToxiQuant and HPLC**

LOD & LOQ

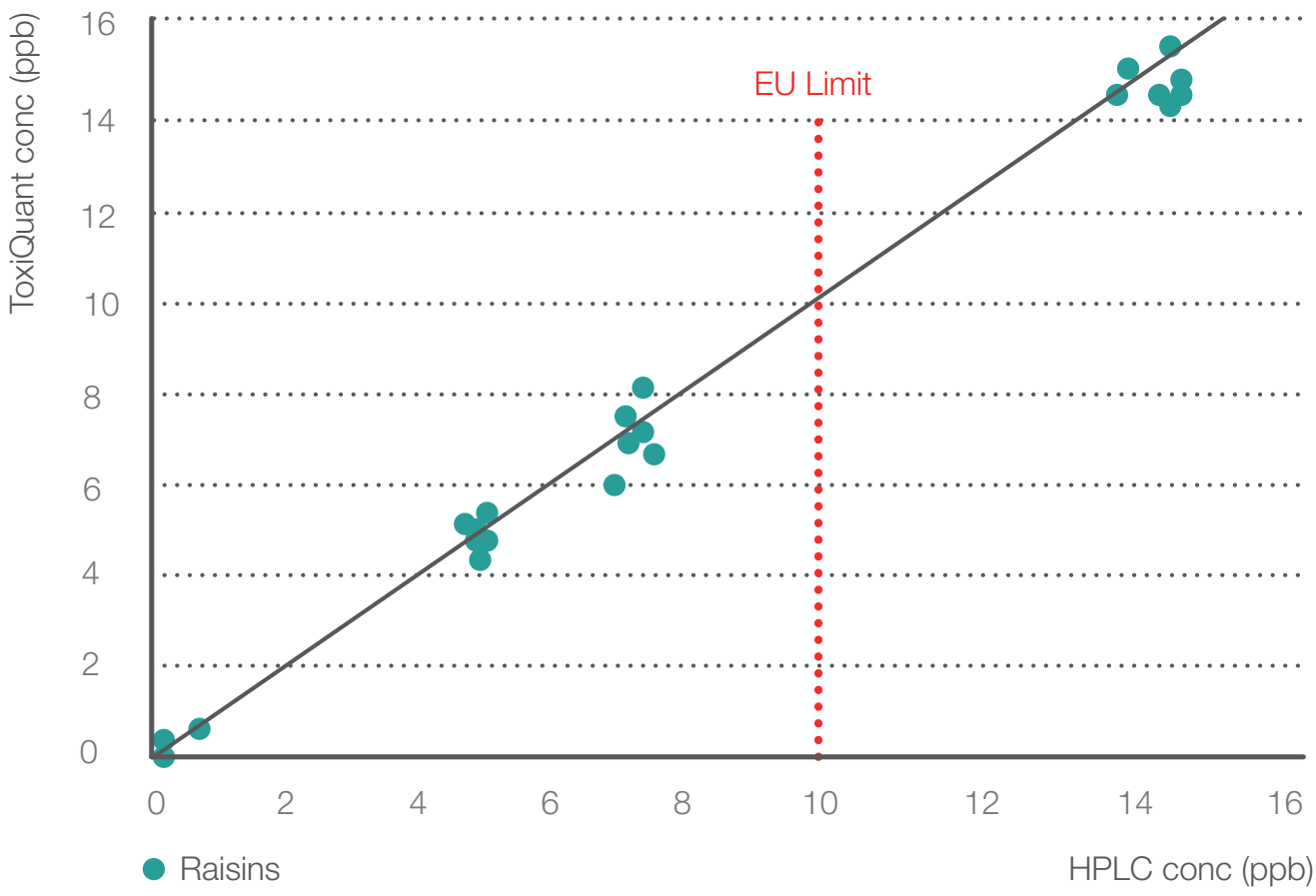
Limit of detection (LOD) and Limit of Quantification (LOQ) of ToxiMet System are well below the EU regulatory levels

(ppb)	LOD	LOQ	Lowest EU limit
Aflaxatoxin B_1	0.20	0.67	2.0
Aflaxatoxin B_2	0.12	0.40	N/A
Aflaxatoxin G_1	0.21	0.72	N/A
Aflaxatoxin G_2	0.04	0.14	N/A
TOTAL	**0.58**	**1.92**	**4**

Weighted linear regression was used to determine the LOD & LOQ (M.Dawlatana, R D Coker, M J Nagler, G Blunden, G W O Oliver, Chromatographia Vol 47, No. 3/4 Feb 1998)

Ochratoxin A in dried vine fruit

ToxiQuant vs HPLC analysis of OTA in Raisins

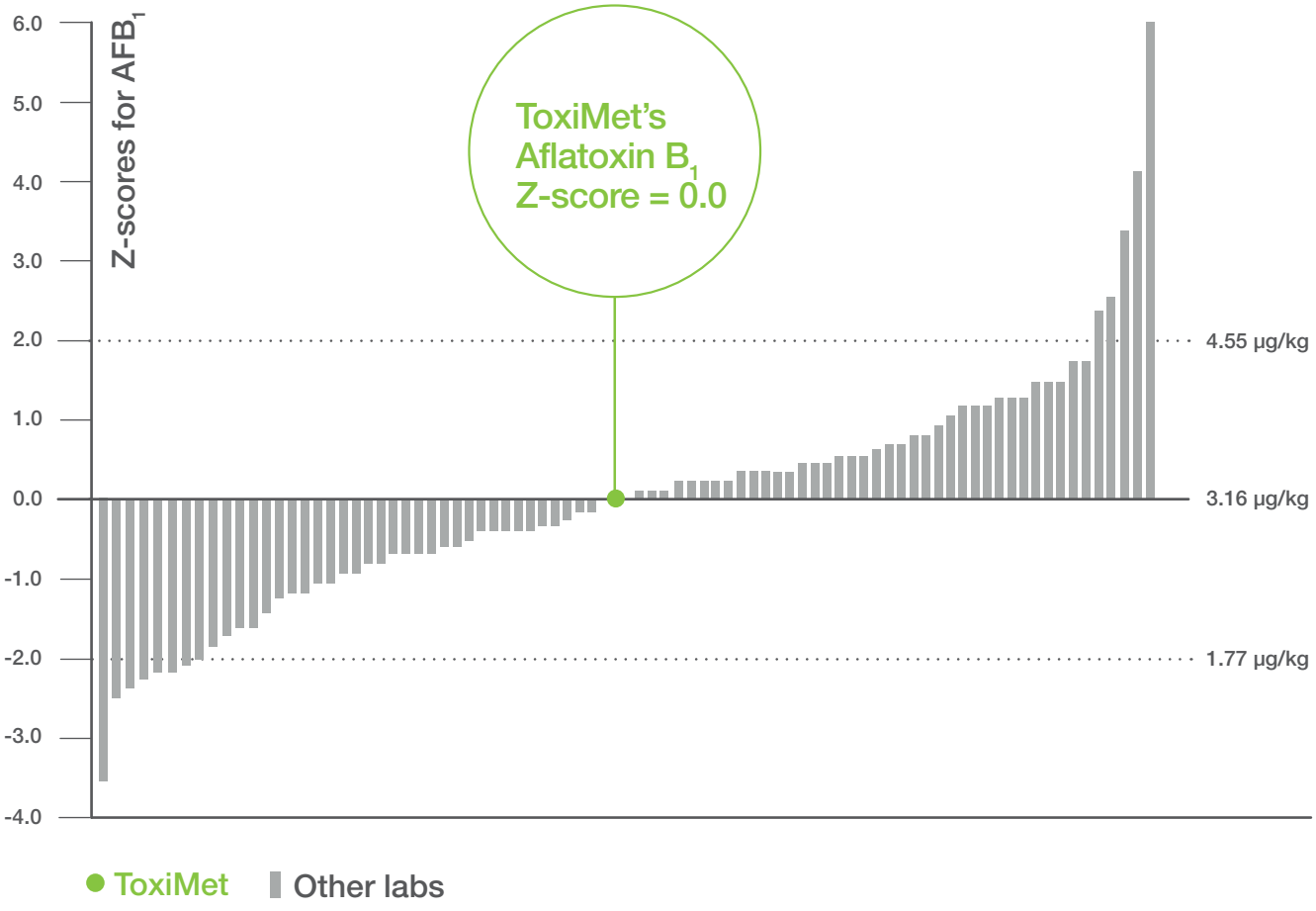


FAPAS proficiency test

ToxiMet's laboratories regularly participate in the Food Analysis Performance Assessment Scheme (FAPAS), to ensure that the HPLC results used as comparison are absolutely accurate.

In a recent FAPAS testing, in which almost 90 international analytical laboratories participated, ToxiMet ranked first, obtaining the closest Z-score to 0 for the combination of Aflatoxin B_1 and Total Aflatoxin precision (and Z=0 for Aflatoxin B_1, as can be seen in the figure below).

ToxiMet was one of the top performers amongst almost 90 participating international analytical laboratories



Accreditation

ToxiMet is currently conducting a joint validation exercise with a leading UK Public Analyst laboratory which will culminate in the granting of UKAS accreditation for the analysis of aflatoxins in edible nuts and rice using the ToxiMet System.

ToxiMet customers around the world are also in the process of obtaining other accreditations for their laboratories in combination with the ToxiQuant system, such as USDA-AMS, ACCREDIA, and VILAS-BoA. The company is also pursuing AOAC and GB/IS certification for the ToxiMet System.



"The ToxiQuant system has completely changed the way we work. It has had a significant effect on storage and shipping times and savings have been realised across our whole business."

Elham Farajpour, Quality Control Manager Cap Kerman

The future

ToxiMet is continually investigating new applications for the ToxiQuant system and recently launched the measurement of Ochratoxin A in dried vine fruit. Also under development are multiple mycotoxin applications in wheat and maize. Testing for pesticides and typical quality parameters are also on the horizon.

The ultimate goal is that ToxiMet's technology is recognised as the gold standard for mycotoxin testing in every food safety and quality laboratory in the world.



ToxiMet won the prestigious INC Innovation Award in May 2013

"We undertook extensive tests with ToxiQuant to ensure that results were in line with HPLC testing. Given the accuracy, simplicity and the speed of response we are very happy with the new system. It also means that we no longer have to factor in time for the external testing of samples when supplying our buyers, so deliveries can be made more quickly"

Le Thi Kim Hue, Purchase and Quality Manager, Olam Vietnam



The ToxiMet System is now available for demonstration at your company. Please contact us to arrange a suitable date or visit our website for further information.

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