



Analysis and regulation to ensure consumer safety

By 2050, the world population is expected to be 9 billion people, and the production of food will need to be doubled.

Many farmers use pesticides to protect crops from environmental pests such as weeds (herbicides), insects (insecticides) and fungi (fungicides). These chemical and biological agents improve cultivation, but toxic pesticide residues can remain in the crops, even after harvesting. Therefore, it is critical to test food products to ensure their safety for human consumption.

In general, the analysis of food and food products is challenging and multi-faceted due to complex matrices. It affords qualitative and quantitative methods with highly specific, sensitive detection.

EURL-authorities for pesticide residue analyses

The European Union Reference Laboratories (EURL) are the authorities for pesticide residue analyses (see Regulation (EC) No. 882/2004). Four specialized EURLs are in place all over the continent. The EURL for fruits and vegetables is located in Almeria, Spain (EURL-FV).

Join the safe side

Accurate detection of pesticides is critical to ensure consumer safety and subsequently the success of food producers. Providing peace-of-mind, Shimadzu's SFC-MS/MS solution for pesticide analysis delivers the robustness and high sensitivity needed to generate accurate, high-quality data for complex samples, meeting all requirements of DG SANTE/11813/2017 and the latest update DG SANTE/11312/2021(V2) implemented since January 2024.

All in one Package

The Shimadzu SFC-MS pesticide analysis package includes hardware (SFC, TQMS, separation column), software and methods for system control and data handling as well as the Quechers sample preparation kits in one complete package: SFC-MS-Pesticide

To learn more about food contaminant testing using Shimadzu instruments, visit www.shimadzu.eu/pesticides



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Ensure consumer safety

SFC-MS/MS solution for pesticide analysis

Limiting exposure to toxic pesticides

Maximum Residue Levels

Maximum Residue Levels (MRLs) are the upper legal levels of a concentration of pesticide residues in or on food to ensure the lowest possible consumer exposure. Commission Regulation (EC) No. 396/2005 lists 320 defined commodities for which 152,000 MRLs have been set.

For baby food, the European legislation is the most restrictive. No more than 0.01 mg/kg of any single pesticide residue is permitted in baby food samples.

Reducing health risks

The hazardous level of a pesticide depends on its toxicity and a person's exposure to it. Just a single exposure can have acute effects, such as impaired vision. Long-term exposure can lead to more serious symptoms and diseases, including cancer. Because of these risks, MRLs have been defined for any food or feed where pesticides are applied correctly according to GAP (Good Agricultural Practice, see Table 1).

Pesticide	Commodity	Parts per Million
Carbetamide	Root and tuber vegetables	0.01
Carbetamide	Bulb vegetables	0.01
Carbetamide	Fruiting vegetables	0.01
Carbetamide	Lettuce and salad plants	0.01
Carboxin	Citrus fruits	0.03
Carboxin	Tree nuts	0.05
Carboxin	Pome fruits	0.03
Carboxin	Stone fruits	0.03
Triflumuron	Lettuce and salad plants	0.01
Triflumuron	Bulb vegetables	0.01
Triflumuron	Lettuce and salad plants	0.01
Triflumuron	Root and tuber vegetables	0.01

Table 1: Examples of MRLs for pesticides in various commodities as published by the EU Commission in Regulation (EU) 2023/2382 of 29 September 2023

Pesticide analysis using SFC-MS/MS

Challenging analysis

Pesticides are complex substances, with multiple pesticide residues belonging to multiple classes. Depending on characteristics such as polarity, volatility, thermal stability and ionization efficiency, the correct type of instrument is chosen:

- a liquid chromatograph (LC) or supercritical fluid chromatograph (SFC) with tandem mass spectrometry detection (LC-MS/MS or SFC-MS/MS) or
- a gas chromatograph tandem mass spectrometer (GC-MS/MS).

These instruments are referred to as triple quadrupole MS (TQMS).

Pesticide analysis by SFC-MS/MS as an alternative to conventional LC-MS/MS

The Nexera UC SFC system with the TQMS LCMS-8060 is the ideal tool for quantitative applications requiring the highest sensitivity and robustness delivering reliable data for routine food analyses. SFC-MS/MS can be used to separate numerous pesticides with different polarities, and it also achieves a marked increase in sensitivity for many compounds. Combining the versatility of SFC with the specificity and sensitivity of MS detection is an appealing alternative to the conventional LC-MS/MS approach.

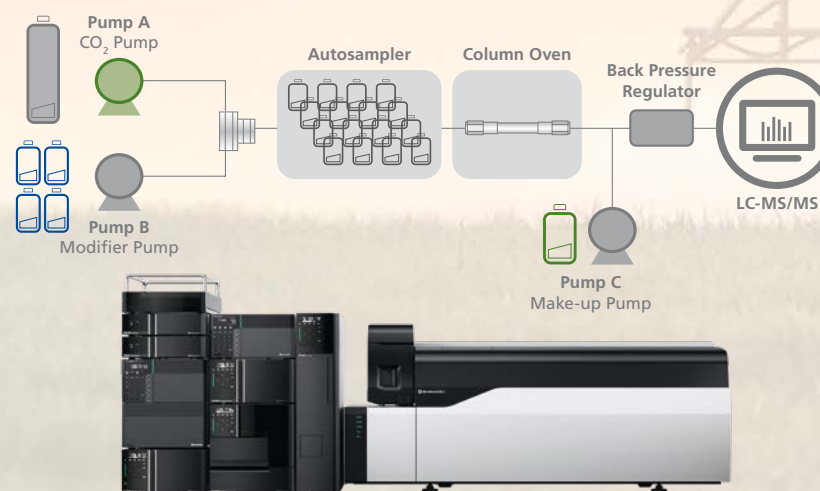


Figure 1: SFC-MS/MS system: Nexera UC with LCMS-8060NX

Unparalleled residue analysis

Reduced matrix effect, shorter run time, less downtime

The EURL-FV in Almeria, Spain, applies SFC-MS/MS for the determination of pesticide residues in food samples with fruit/vegetable matrices such as tomato, leek and orange, or spices such as red and black pepper, following the identification requirements of DG SANTE/11813/2017.

Routine pesticide residue analysis using "MRM Spectrum Mode"

To help reduce the risk of false positive or negative reporting in pesticide residue screening, multiple-reaction monitoring (MRM) methods have been applied to record a higher number of fragment ion transitions, increasing specificity and reporting confidence. Using the Shimadzu Pesticide MRM Library allows for quick and easy peak identification.

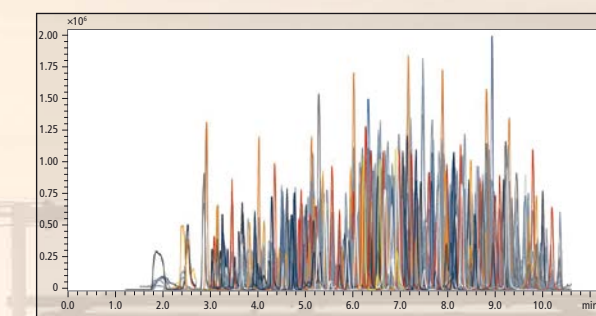


Figure 2: MRM chromatograms of 646 pesticides spiked into a mint extract at 0.01 mg/kg (up to 3 MRMs per compound and 5 msec polarity switching time)

QuEChERS sample preparation

Effectively supporting SFC-MS/MS analysis, the QuEChERS ("catchers") method is a fast and simple alternative to conventional sample preparation for multi-residue pesticide analysis. Dedicated extraction kits make QuEChERS easy to reproduce.

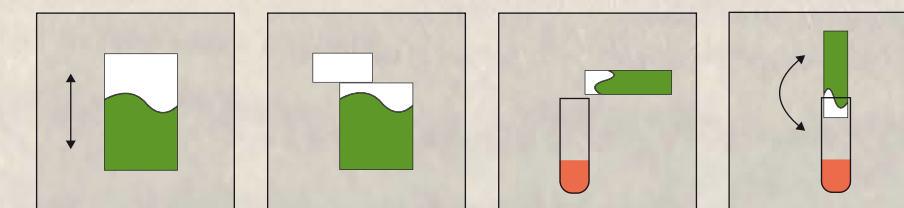


Figure 3: Easy sample preparation using Q-sep extraction kits