SHIMADZU
Excellence in Science

Analytical and Testing Instruments for Food Safety

Shimadzu's Total Support for Food Safety

World Map of Shimadzu Sales, Service, Manufacturing, and R&D Facilities

Sales and Service
Manufacturing
R&D

Shimadzu's Total Support for Food Safety

Shimadzu provides total support for food safety, whether it is farm to fork or bait to plate. As a leading manufacturer of a wide range of analytical instruments, Shimadzu undertakes development of new instruments and technologies, and provides comprehensive service support in order to keep up with changing market demands.

Analysis of Residual Pesticides

Food knows no borders. With an increasing global population, food security is increasingly under threat and there is a growing challenge for agriculture to produce more food, safely and more sustainably. The use of herbicides, insecticides, and fungicides reduce crop losses both before and after harvest, and increase crop yields. However, pesticide residues resulting from the use of plant protection products on crops may pose a risk to human health; as a result, regulatory guidelines have been implemented to monitor pesticide residues in food. Shimadzu offers a wide range of instruments for pesticide testing, from GC and LC with specific detectors to single and triple quadrupole mass spectrometers.

Triple Quadrupole Mass Spectrometer LCMS-8060

The LCMS-8060 is a groundbreaking innovation in mass spectrometry, helping to transform LC-MS/MS data quality by developing a new vision of sensitivity and speed.
Shimadzu is the first mass spectrometry company in the world to deliver a triple quadrupole mass spectrometer with the highest sensitivity and ultra-fast technologies.

Database

LC/MS/MS Method Package for Residual Pesticides

The Method Package covers 836 components subject to EU Directive No. 396/2005, Chinese GB standards, and the Japanese Multi-residue Method for Agricultural Chemicals by LC-MS/MS. In the USA, the EPA sets the pesticide limits while the FDA and USDA enforce those limits. The method package also includes optimized analytical conditions, which enables simultaneous analysis of 646 pesticides in 10.5 minutes without performing a complicated conditions setting process.

Method File	Mode	Registered Component
Pesticide	MRM	836

Simultaneous Analysis of Residual Pesticides (LC-MS/MS)

LC-MS/MS MRM (Multiple Reaction Monitoring) analysis allows for rapid and sensitive detection of pesticides in complex matrices. An example of simultaneous multi-residue multi-class pesticide analysis is shown below.
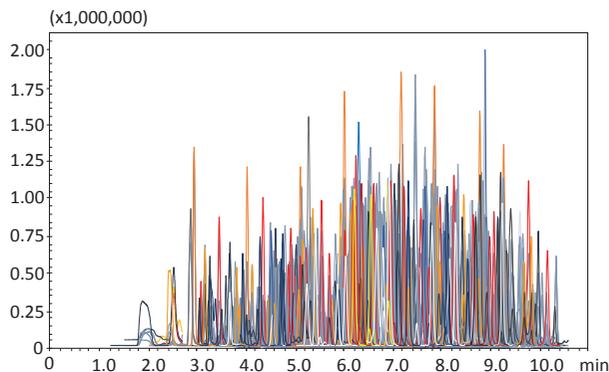
Simultaneous Analysis of 646 Pesticides (10ng/mL) within 10.5 minutes Using LC-MS/MS
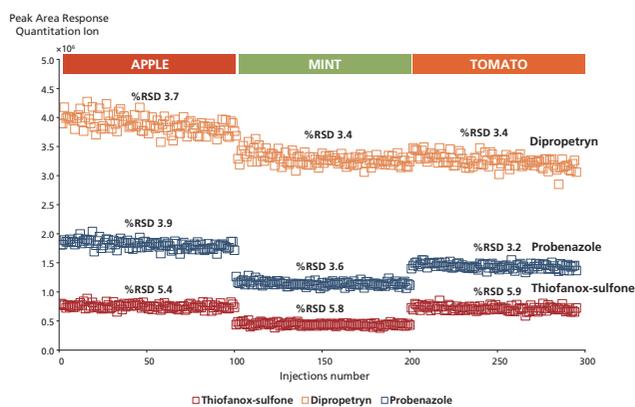
Peak Area Response for Three Pesticides Spiked into Apple, Mint and Tomato Matrix Extracts at 0.05 mg/kg over 72 Hours.

Source: Shimadzu Application News No. C136

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Analysis of Residual Pesticides

Simultaneous Analysis of Residual Pesticides (GC-MS/MS)

(×1,000,000)
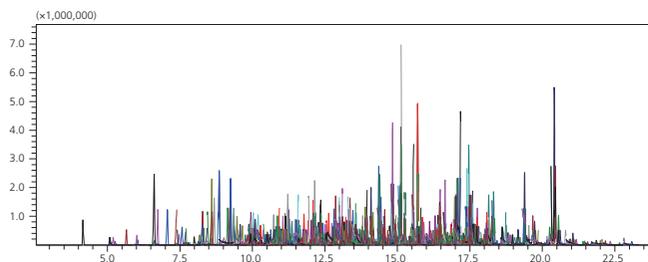
Simultaneous Analysis of 439 Pesticides Using GC-MS/MS with Smart MRM

Source: Shimadzu Application Data Sheet No. C106, 107

Triple Quadrupole Mass Spectrometer GCMS-TQ8050

Finally, a triple quadrupole GC-MS/MS Smart enough for everyday use in your laboratory. The Shimadzu GCMS-TQ8050 is the first triple quadrupole with Smart Productivity for high-efficiency sample throughput, Smart Operation for quick and easy method development, and Smart Performance for low detection limits and Scan/MRM. These three smart technologies contribute to Smart MRM and provide the most accurate, cost-effective, and easy-to-use triple quadrupole GCMS you have ever imagined.

Database

Database for Quantitative Analysis
Smart Pesticides Database

The Smart Pesticides Database includes optimized transitions and collision energies, CAS registry numbers, and Retention Indices (RI) for hundreds of pesticides. Select from pre-registered compounds in one database, or add you own optimized transitions. Select the compounds to be analyzed, and Smart MRM builds the MRM or Scan/MRM acquisition method from the "Smart Database" with a push of a button.

Database for Screening Analysis
Quick-DB*

MS Residual Pesticides Database

In pesticide analysis, increased purchasing costs and the control operations associated with standard samples have become issues for the industry. The Quick-DB contains information on 491 components, optimized analytical conditions, and calibration curves created using pesticide surrogates as internal standard substances. This allows quick screening of residual pesticides without using pesticide standard samples.

*Not available in the USA

Multi-Analyte Quantitation Software
LabSolutions Insight

Due to increasingly sophisticated automation, large quantities of high-quality mass spectrometer data can be obtained. However, checking and analyzing all that data can be extremely time-consuming, which significantly decreases the efficiency of inspection work. LabSolutions Insight multi-analyte quantitation software for GC-MS/MS and LC-MS/MS analysis helps analyze such multi-analyte data more conveniently and more efficiently.

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Analysis of Residual Pesticides

Gas Chromatograph (GC)

Capillary GC can be utilized for the analysis of residual pesticides in foods. Using a selective detector such as FPD, FTD or ECD offers highly sensitive analysis of trace pesticides.

Chromatograms of Normal Meat Sample and Pesticides-spiked Meat Sample

▌ Gas Chromatograph Nexis GC-2030

Features

Easy Operation

An advanced interface enables intuitive operation with clear graphics. Shimadzu's latest tool-free maintenance technology makes daily maintenance easy.

High Sensitivity and Reproducibility

Achieves high sensitivity with all of the detectors, such as FID and BID. The advanced flow controller (AFC) enhances reliability with excellent repeatability.

Exceptional Expandability and Productivity

Nexis GC-2030 can be customized to meet customers' specific requirements and needs. Options and functions to use hydrogen carrier gas safely in high-speed analysis maximize analysis productivity.

Liquid Chromatograph (LC)

GC or GC-MS techniques may not be suitable for analysis of residual pesticides that thermally decompose or have a highly polar chemical structure. In contrast, an HPLC equipped with a photodiode array detector can acquire reliable chromatograms with spectral information for building libraries to compare compounds. The Shimadzu carbamate analysis system incorporates derivatization technologies to achieve high-sensitivity, selective analysis of N-methyl carbamate pesticides.

Chromatogram of a Standard Mixture of 10 N-Methylcarbamate Pesticides

▌ High-Performance Liquid Chromatograph Prominence Series Carbamates Pesticides Analysis System

Features

Rapid Injection

An injection time of 10 seconds for a 10 µL sample enhances analysis efficiency.

High Sensitivity and Linearity over a Broad Range

Upgraded optical and electrical systems reduce noise for lower detection limits and ensure simultaneous analysis of major components and trace components.

Low Sample Carryover

Platinum coating minimizes the adsorption of sample components on to the needle surface.

Analysis of Veterinary Pharmaceuticals

Veterinary pharmaceuticals are used in the diagnosis, cure, mitigation, treatment, and prevention of diseases in animals as well as in the promotion of growth. However, there is increasing concern about these drugs entering the food chain and their effects on the human body. These drugs are categorized in many classes, such as anabolic hormones, anthelmintics, antibiotics, beta-agonists, coccidiostats, corticosteroids, nonsteroidal anti-inflammatory drugs (NSAIDs), and sedatives. Below are a few examples of veterinary pharmaceutical analyses.

Analysis of Multiple Veterinary Pharmaceuticals in Pork (LC-MS/MS)

Veterinary pharmaceuticals are often used to promote the growth of farm animals, but many of these compounds are subject to residue standards. From this background, there is a need for a highly sensitive and rapid analytical technique to analyze as many of these compounds as possible in a single run. LC-MS/MS enables simultaneous analysis of multiple veterinary pharmaceuticals with high sensitivity.

Triple Quadrupole Mass Spectrometer LCMS-8060
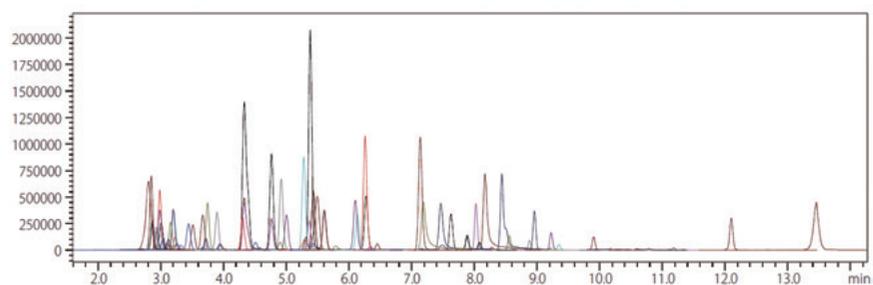
MRM Chromatograms of 89 Veterinary Pharmaceuticals in Pork

Source: Shimadzu Application News No. C99

Analysis of Veterinary Pharmaceuticals Using MRM Spectrum Mode (LC-MS/MS)

MRM Spectrum Mode was developed to reduce false positives and false negatives in analysis of veterinary pharmaceuticals. MRM Spectrum Mode acquires a high number of fragment ion transitions for each target compound and generates fragmentation spectra. In examination of quantifying and identifying 212 veterinary pharmaceuticals, the level of confidence in compound identification and verification increased in MRM Spectrum Mode, and limits of detection, linearity or repeatability were not compromised compared to a conventional method (2 MRM / compound).
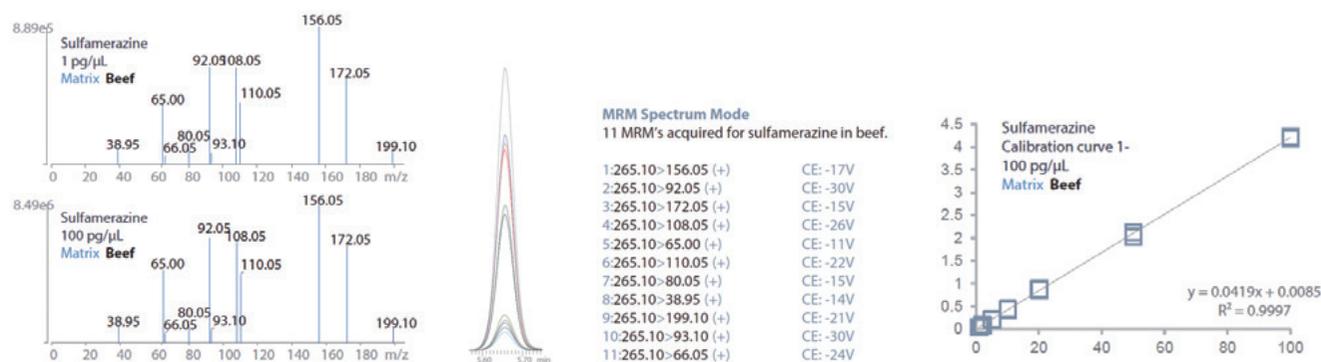
MRM Spectra and Calibration Curve of Sulfamerazine (1 pg/µL to 100 pg/µL)

Source: Shimadzu Application News No. C161

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Analysis of Mycotoxins

Mycotoxins are chemical products produced in fungus and are toxic to humans, animals, and crops. There are more than 300 known mycotoxins, including aflatoxin, deoxynivalenol, patulin, fumonisin and others, and some of them are strictly controlled under regulations. HPLC and LC-MS are mainly used for analysis of mycotoxins, and simultaneous analysis of multiple mycotoxins has been carried out for more efficient screening.

Analysis of Aflatoxins (LC)

The analysis of aflatoxins (B1, B2, G1 and G2) is very important from a food safety perspective due to concerns about adverse effects on human health. The Nexera Ultra High Performance Liquid Chromatograph achieves high-resolution analysis of aflatoxins in less than four minutes. The RF-20Axs high-sensitivity fluorescence detector allows direct analysis of aflatoxins at trace levels (ppt) without any derivatization.

Peaks
1 AFG2 (0.6 µg/kg)
2 AFG1 (2.4 µg/kg)
3 AFB2 (0.6 µg/kg)
4 AFB1 (2.4 µg/kg)

Integrated HPLC
Nexera-i
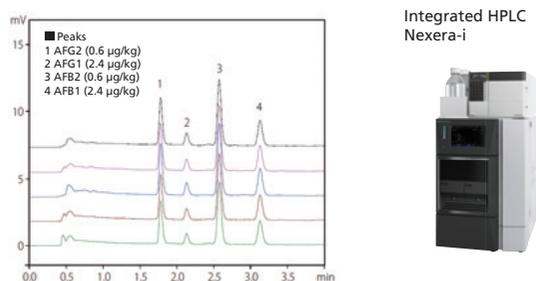
Analysis of Aflatoxins without TFA Derivatization (N = 5)

Source: Shimadzu Application News No. L435

Simultaneous Analysis of 25 Mycotoxins (LC-MS/MS)

LC-MS/MS is effective for analysis of mycotoxins in complex matrices. Shown is an example of the simultaneous analysis of 25 mycotoxins by LC-MS/MS and the Method Package for Mycotoxins. All compounds, including positive and negative ions, were separated and detected with high sensitivity within 12 minutes. For analysis of mycotoxins with high sensitivity, eliminating carryover is indispensable. Modified rinse methods using the SIL-30AC autosampler can eliminate carryover of fumonisins.
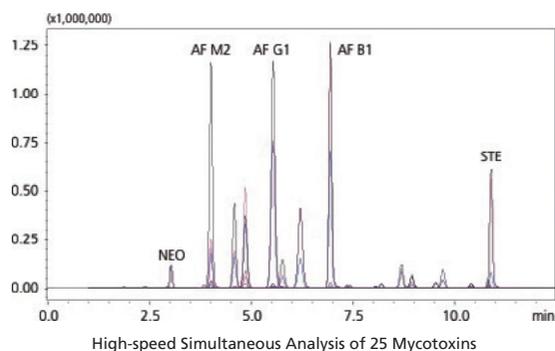
High-speed Simultaneous Analysis of 25 Mycotoxins

Source: Shimadzu Flyer No. C146-E351

Rapid Screening of 10 Mycotoxins (LC)

Simultaneous analysis of mycotoxins is important because multiple mycotoxins have been detected in a single food and may cause a synergistic effect. From this background, a simultaneous analytical method has been developed for rapid screening of 10 mycotoxins using HPLC. Shown below are chromatograms of 10 mycotoxins by fluorescence (upper) and PDA (lower) detectors without derivatization.

Peaks
1) AFM$_1$ 1 µg/L
2) AFG$_2$ 0.25 µg/L
3) AFG$_1$ 0.25 µg/L
4) AFB$_2$ 0.25 µg/L
5) AFB$_1$ 0.25 µg/L
6) ZON 50 µg/L
7) OTA 5 µg/L

Peaks
8) NIV 1000 µg/L
9) DON 1000 µg/L
10) PAT 25 µg/L

Simultaneous Analysis of 10 Mycotoxins

Source: Shimadzu Application News No. L512

Database

LC/MS/MS Method Package for Mycotoxins

The Method Package provides simultaneous multi-component analysis conditions for mycotoxins subject to regulations in the US, the EU, China and Japan. It contains seven different analytical method conditions and fully optimized MRM transitions for a total of 27 different mycotoxins. Rapid analytical methods are included for a 25 mycotoxin screen, 16 mycotoxins using high-sensitivity conditions, 10 mycotoxins using APCI, and specialized methods for trichothecenes, fumonisins, aflatoxins, and patulin.

Method	Number of Components	Analysis Time (min)
Simultaneous Analysis of 25 Mycotoxins	25	15
Simultaneous Analysis with High Sensitivity	16	30
Patulin Analysis	1	10
Aflatoxins Analysis	6	30
Trichothecenes Analysis	4	12
Fumonisins Analysis	3	15
10 mycotoxins using APCI	10	33

Identification and Observation of Microorganisms

In the event of food poisoning, identification of the causative factor is extremely important in determining the path of infection, prescribing treatment and preventing recurrence. Shimadzu's iDPlus microorganism identification platform provides rapid identification of microorganisms in food.

Identification of Microorganisms (MALDI-TOF-MS)

In order to prevent pathogenic germs from contaminating food sources, it is essential to identify them quickly and reliably in order to allow for proper controlled measures. A microorganism identification system using the AXIMA MALDI-TOF MS enables direct measurement of cultured microorganisms and identification within two minutes.
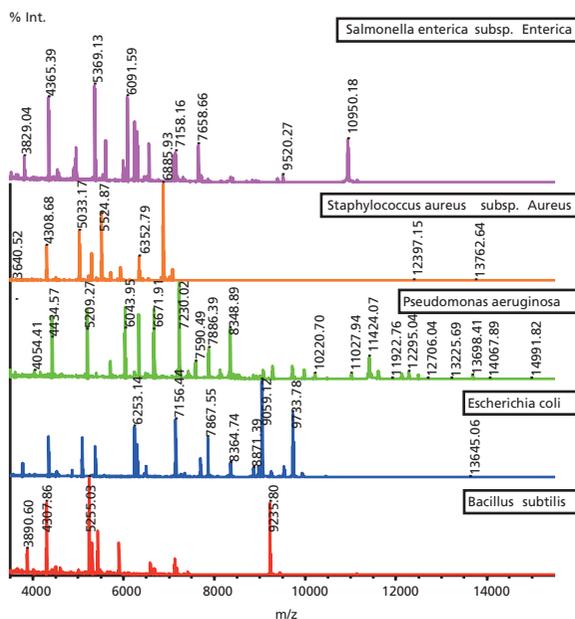
Comparing mass spectra of different bacteria

Source: https://www.shimadzu.com/an/industry/pharmaceuticallifescience/proteome0207005.htm

What is Microorganism Identification by MALDI-TOF MS?

Species-specific mass spectral patterns from microorganisms can be obtained by direct measurement of microorganisms using MALDI-TOF MS. Identification of microorganisms can be performed by matching these collected spectra to the database. This is a fast, easy and reliable method for identification of microorganisms.

AXIMA Microorganism Identification System

Features

Quick and Easy Analysis
Three steps from sample preparation to identification.
The microorganism identification process is finished within two minutes after starting the analysis.

Highly Accurate Identification
Microorganism identification by MALDI-TOF MS is a well-established technique with a low number of false positives.

Applicable for a Wide Range of Microorganisms
Capable of classifying/identifying gram-positive and gram-negative bacteria, yeasts, fungi and spores. iDPlus identifies mircoorganisms by family, genus, species, and subspecies.

Database Customization
Easily register new microorganisms in the database, which allows rapid development of a high-quality database.

Low Operational Cost
Analysis can be performed for pennies per sample compared to expensive traditional techniques.

Expanded Research Capabilities
iDPlus is not limited to microorganism identification. Reflectron mode and MS/MS functionalities enable a true research platform.

Analysis of Toxic Metals

Toxic metals (arsenic, lead, cadmium, etc.) in foods must be controlled down to low concentration levels. Shimadzu atomic absorption spectrophotometers and ICP emission spectrometers offer highly sensitive analysis of trace elements in foods. Shimadzu's product lineup also includes X-ray fluorescence spectrometers that can perform elemental analysis without sample pretreatment. These instruments are ideal for screening analysis and emergency analysis.

Analysis of Cd and Pb in Food Additives (AA)

Shown here is an analysis of cadmium (Cd) and lead (Pb) in α-cyclodextrin (cyclic oligosaccharide), a substance used in functional foods, pharmaceuticals, cosmetics, etc. The analysis was conducted by the AA-7000 atomic absorption

Peak Profiles of Cd and Pb

Analysis of Trace Element Contamination in a Fish Sample (ICP)

Fish Protein Certified Reference Material for Trace Metals (DORM-4) was used as the fish sample. The Shimadzu ICPE-9800 can provide a rapid method to simultaneously analyze trace elements in fish. The results show excellent correlation with the certified reference material.
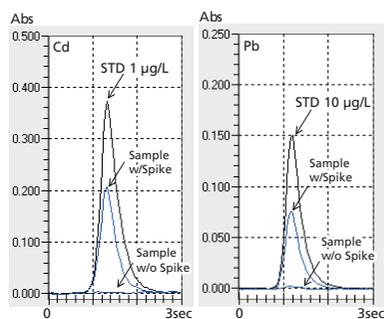
Atomic Absorption Spectrophotometer AA-7000

Measurement Results of Cd and Pb in α-cyclodextrin

Element	Cd	Pb
Measured value	<0.003 µg/g	<0.07 µg/g
Spike and recovery rate	105 %	99 %

ICP Atomic Emission Spectrometer ICPE-9800 Series
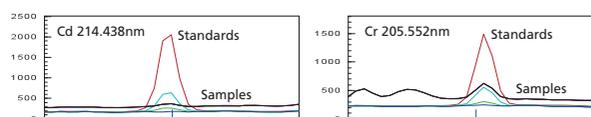
Peak Profiles of Cd and Cr

Usage and Features of Elemental Analysis System

Product	Usage / Feature	Sample
Atomic Absorption Spectrophotometer AA-7000 Series	Atomic absorption spectrophotometry is widely used for tests compliant with various standards due to its high sensitivity. AA-7000 offers superior expandability due to its flexible system configuration. It also offers numerous safety features, such as a vibration sensor and a gas leakage detection system, as standard.	Liquid (or sample dissolved in solvent)
ICP Atomic Emission Spectrometer ICPE-9800 Series	ICP atomic emission spectrometry is widely used for tests compliant with various standards due to its high sensitivity and rapidity when performing multi-element simultaneous analyses. ICPE-9800 series offers numerous features, including the simultaneous analysis of all elements, simple operation with its assistant functions, and low running costs.	Liquid (or sample dissolved in solvent)
ICP Mass Spectrometer ICPMS-2030	ICP mass spectrometry is a method of analysis that provides ultra-high sensitivity at ppt levels in addition to simultaneous multi-element analysis capabilities. ICPMS-2030, while being highly sensitive, also offers low running costs by reducing the argon gas flow. It also greatly improves the reliability of data through its assistant functions.	Liquid (or sample dissolved in solvent)
X-Ray Fluorescence Spectrometer EDX-7000/8000	X-ray fluorescence spectrometry makes possible the nondestructive analysis, without pretreatment, of the elements in solid, powder, or liquid samples. EDX-7000/8000 are capable of detecting sub-ppm level heavy elements. Offering low running costs and superior maintenance features, these instruments are suitable for the screening of toxic metals.	Solid, powder, liquid

Analysis of Food Additives

A wide variety of additives, such as preservatives, flavor enhancers, coloring agents and antioxidants, are used on foods. Strict monitoring of food stuffs is essential to detect the use of prohibited chemicals. Each country assigns a unique number or code of approved chemicals for that country. Shimadzu offers a wide range of products for detecting the prohibited chemicals, whether they were added intentionally or through contamination.

Analysis of Dicyandiamide and Melamine in Milk Powders (LC-MS/MS)

Melamine was found to be used as a protein-rich adulterant in pet food in 2007, and then in infant formula in 2008 in China. The outbreak of the melamine scandal that killed many dogs and cats as well as led to the deaths of six infants and illness of many others caused panic and great concerns worldwide. Recently, low levels of dicyandiamide (DCD)

residues were found in milk products from New Zealand. Instead of being added directly as an adulterant, the trace DCD, which is used for promote the growth of cow pastures, found in milk products was explained to be relating to the grass "contaminated by DCD".

Calibration Curves of DCD and Melamine
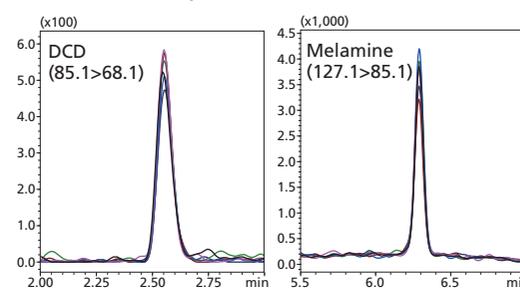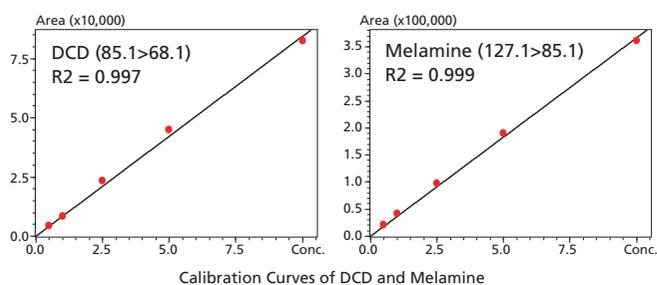
Overlapping of Six MRM Peaks of 0.5 ng/mL DCD and Melamine in Milk Powder Matrix

Analysis of Preservatives in Food (UV)

Below are examples of the analysis of food samples spiked with preservatives.

Sodium Nitrite in Meat

Sorbic Acid in a Processed White Fish Product

UV-VIS Spectrophotometer UV-1900

Features

High Performance
- Ultra-fast scan speed (29,000nm/min)
- Low stray light (less than 0.5% at 198nm)
- High photometric repeatability (less than ±0.0002Abs at 0.5Abs and 1.0Abs)

Intuitive Operability
Easy-to-navigate color touch-screen display

Instrument Validation
Automatic/semi-automatic validation of wavelength accuracy and wavelength reproducibility.

Analysis of Sudan Dyes in Curry Powder (LC)

Sudan dyes are oil-soluble synthetic dyes used in industrial products. Their use is not authorized in food products in some countries. This is an example of LC analysis of Sudan dyes in curry powder.

Peaks
1 Sudan Orange G-a
2 Sudan Orange G-b
3 Sudan Red G
4 Sudan I
5 Sudan II
6 Sudan III
7 Sudan Red 7B
8 Sudan IV
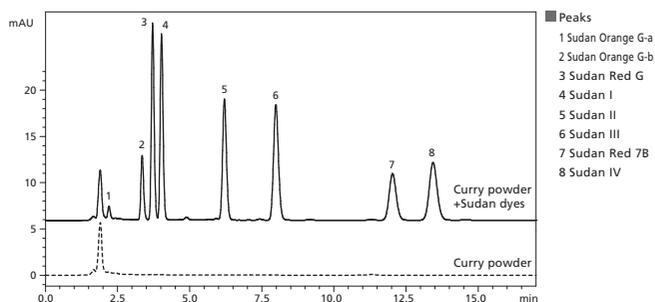
Sudan Dyes in Curry Powder

Source: Shimadzu Analysis Guidebook No. C180-E059, page 77

Shimadzu's Total Support for Food Safety

Analysis of Food Additives

Since food additives are widely used in food products, simultaneous analysis is essential to confirm proper use of them. Efficient methods using GC-MS and LC-MS have been established for the simultaneous determination of several food additives like flavor enhancers and sweeteners. With these simultaneous analysis methods, multiple compounds can be efficiently analyzed in short time.

Single Quadrupole Mass Spectrometer
GCMS-QP2020

Simultaneous Analysis of Flavor Compounds (GC-MS)

GC-MS is commonly used for analysis of flavor compounds. Shown is an example of a simultaneous analysis of 19 flavor compounds in lavender oil using a Fast GC/MS Method. All compounds were separated within six minutes.

Peaks

1 alpha-Pinene	6 Limonene	11 Isoborneol	16 (Z)-beta-Farnesene
2 Camphene	7 Eucalyptol	12 alpha-Terpineol	17 Germacrene D
3 beta-Pinene	8 gamma-Terpinene	13 Linalyl acetate	18 beta-Bisabolene
4 Myrcene	9 Linalool	14 Bornyl acetate	19 Caryophyllene oxide
5 Cymene	10 Camphor	15 Neryl acetate	
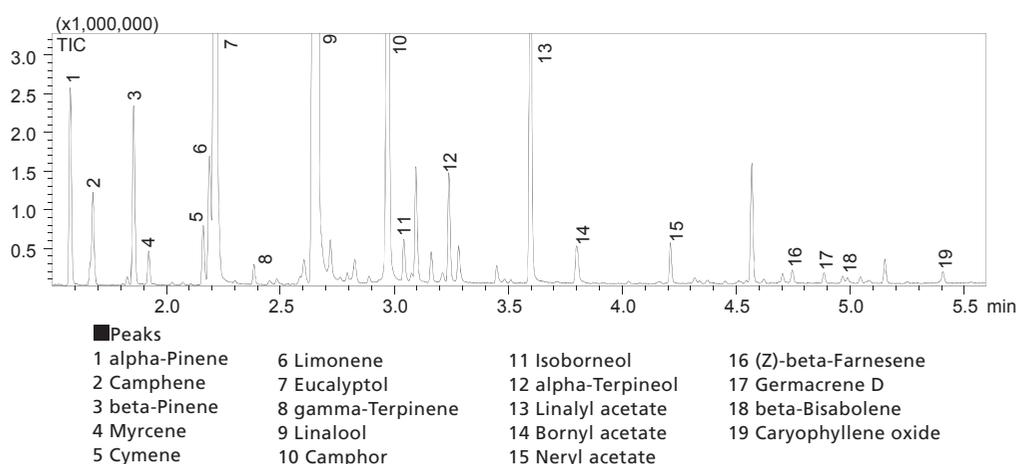
Source: Shimadzu Application Data Sheet GCMS No. 32

Triple Quadrupole Mass Spectrometer
LCMS-8060

Simultaneous Analysis of Sweeteners (LC-MS/MS)

A wide range of low-calorie sweeteners are often used in foods. They are used together with sugars, and multiple sweeteners are combined to regulate flavors. This example shows the simultaneous analysis of 16 sweeteners. Good linearity was obtained with a correlation coefficient of 0.997 or higher for all the compounds.

Compound Name	Polarity	Transition	Holding Time (min)	Calibration Curve Range (ng/mL)			Correlation Coefficient
Sucralose	+	414.00>199.10	6.36	0.5	-	100	0.999
Dulcin	+	181.20>108.10	6.70	0.05	-	10	0.999
Alitame	+	332.20>129.00	6.92	0.5	-	100	0.999
Rebaudioside A	+	984.50>325.10	8.21	0.5	-	100	0.999
Stevioside	+	822.00>319.30	8.23	0.5	-	100	0.999
Acesulfame potassium	−	161.90>82.00	5.23	0.1	-	10	0.999
Saccharin	−	181.90>42.00	5.58	0.5	-	50	0.997
Cyclamate	−	178.00>80.00	6.08	1	-	100	0.999
Aspartame	−	293.40>261.10	6.53	5	-	100	0.999
Advantame	−	457.30>200.30	7.12	0.5	-	100	0.999
Glycyrrhizic acid	−	821.20>351.10	7.41	50	-	1000	0.999
Rebaudioside M	−	1289.60>802.90	7.66	50	-	1000	0.999
Neotame	−	377.30>200.00	7.90	1	-	100	0.999
Rebaudioside C	−	949.50>787.20	8.46	1	-	100	0.999
Dulcoside A	−	787.50>625.20	8.50	10	-	1000	0.999
Isosteviol	−	317.30>317.30	10.46	0.5	-	1000	0.999

Source: Shimadzu Application News No. C133.

Food Processing

Food processing takes a farmed product and turns it in to an edible, marketable product that may have a longer shelf life. Examples of these processes are baking, canning, fermenting, grilling, heating, hydrolysis, and roasting. During these processes, undesirable and even toxic compounds can form. Or cross-contamination can occur from the big eight allergens of egg, fish, milk, peanuts, shellfish, soy, tree nuts, and wheat.

Analysis of Acrylamide in Potato Chips (LC-MS/MS)

Acrylamide was found to form in fried foods like potato chips via the so-called Maillard reaction of amino acid asparagine and reducing sugar glucose at a higher temperature (120°C). The health risk of acrylamide present in many processed foods was an immediate concern, because it is known that the compound is a neurotoxin and a potential carcinogen to humans.
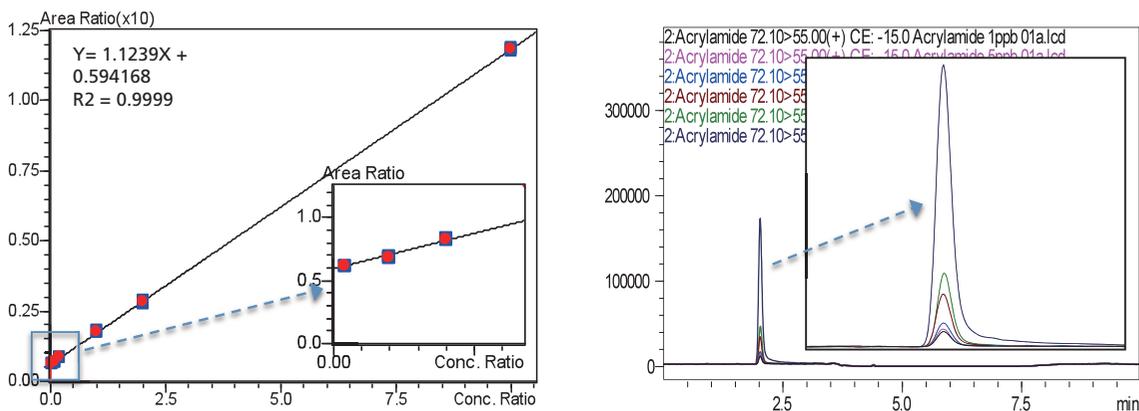
Calibration Curve (left) and MRM Peaks (right) of Acrylamide Spiked into Potato Chips Matrix, 1-500 ppb with 50 ppb IS (internal standard) Added.

Analysis of Allergens

Food allergies are a major concern due to their adverse health effects. To avoid unexpected contact with food allergens, many countries stipulate the application of food labels that indicate the presence of specific allergens. An example of the simultaneous analysis of allergens using LC-MS/MS is shown; it contains 150 MRMs for 31 peptides of 13 allergenic proteins identified from 8 foods regulated in the US (milk, eggs, fish, crustacean shellfish, tree nuts, peanuts, wheat and soybeans). They were successfully detected with high sensitivity and selectivity.

Triple Quadrupole Mass Spectrometer
LCMS-8060

Simultaneous Analysis of Food Allergens (LC-MS/MS)

Chromatogram of a peptides mixture derived from eight food allergens, and a magnified view of five MRM transitions for wheat peptides and its calibration curve.
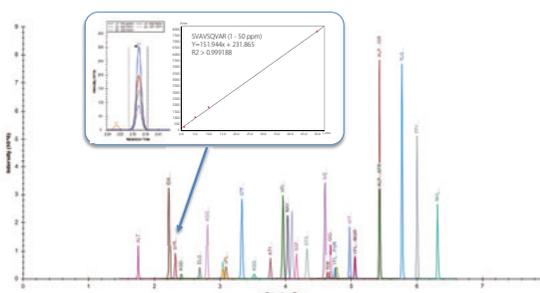
Source: Shimadzu Application News No. C160

Chromatogram of Different Bread Types

Ordinary Bread

Gluten Free Bread
Spiked with 10 ppm of Wheat
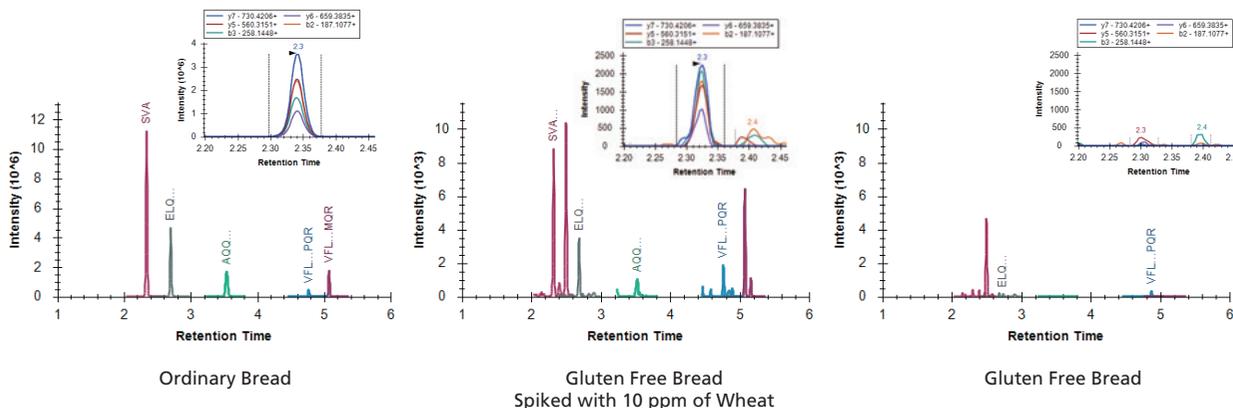
Gluten Free Bread

Analytical Results of Allergens in Food Samples

Food	Allergens	Bread		Gluten Free Bread		Peanut Cookies		Frozen Fish "Fried Cod"		Frozen Pasta "Garlic Shrimps"	
		Label	Detect	Label	Detect	Label	Detect	Label	Detect	Label	Detect
Milk	Bos d 8 Bos d 5					-	× ×	×	× ×	×	× ×
Egg	Gal d 2 Gal d 3	×	× ×			-	× ×				
Atlantic Cod	Gad m 1					-		×	×		
Whiteleg Shrimp	Lit v 1 Lit v 3 Lit v 4					-				×	× × ×
Almonds	Pru du 6					-					
Peanuts	Ara h 1					-	×				
Wheat	Tri a 26 Tri a 36	×	× ×			-	× ×	×	× ×	×	× ×
Soybeans	Gly m TI			×	×	-					×

14

Analysis of Off-Flavor

If unforeseen circumstances occur during food product manufacture, storage, transport or other process and an off-flavor issue occurs, it is necessary to specify the odor-causing substances in order to resolve the problem and prevent a recurrence. Shimadzu provides a total solution necessary for analyzing odors combining GC-MS and a database for off-flavor analysis, so even analysts without knowledge or experience of off-flavor analysis can start analysis.

Off-Flavor Analyzer
GCMS-8050 + Database for Off-Flavor Analysis

Features

Database of Expert Information for Odor Analysis

Database containing odor-causing substances identified from previous problems and associated sensory information supports odor analysis.

Analytical System for Reliably Identifying Odor-causing Substances

Optimized sample pretreatments and analytical conditions including three types of columns, SIM/MRM conditions and retention time enable effective identification of odor-causing substances.

What is the Off-Flavor Analyzer?

This system combines a database of the major odor-causing substances and associated sensory information (odor characteristics and threshold levels for sensing odors) with GC-MS. Even analysts without knowledge or experience of off-flavor analysis can start an analysis easily.

Containing Experts' Knowhow for Odor Analysis

Odor Components   Analytical Conditions   Sensory Information of Odor Components

Analysis of Food Product Samples Involved in Off-Flavor Complaints

In the analysis of food product samples involved in off-flavor complaints, it was confirmed that four components are more often found in off-flavor products than in normal products. The four components detected were further analyzed using the off-flavor analysis database, and concentration and odor threshold values as well as odor characteristics were confirmed. From the results, 2,4,6-trichloroanisole was identified as an odor-causing substance.

p-dichlorobenzene   pelargonic acid   2,4-dichloroanisole   2,4,6-trichloroanisole
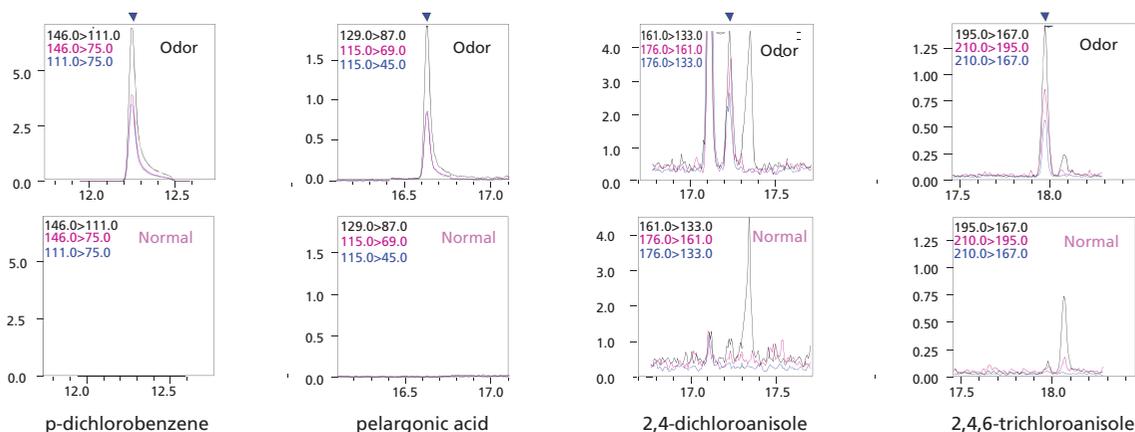
Four Higher Concentration Compounds in Odor Sample	Estimated Concentration (pg/mg)		Odor Threshold Values (pg/mg)	Odor Characteristics
	Normal Sample	Odor Sample		
p-dichlorobenzene	0.052	66.558	1000.000	Insecticide
pelargonic acid	0	0.851	100.000	Acid like dried fruits
2,4-dichloroanisole	0	0.003	10.000	Mold
2,4,6-trichloroanisole	0	0.009	0.001	Mold

Source: Shimadzu Technical Report No. C146-E293

Shimadzu's Total Support for Food Safety

Inspection and Analysis of Foreign Matter

Foreign matter can become mixed with food products during the production process for a variety of reasons. The discovery and identification of foreign matter and ascertaining its source are essential for maintaining food safety.
Shimadzu's non-destructive testing and analytical technologies can be used to detect foreign matter that is not externally visible and analyze for the elemental or molecular components.

Analysis of Inorganic Foreign Matter (EDX)

An energy-dispersive X-ray fluorescence (EDXRF) spectrometer permits the easy and rapid identification of inorganic foreign matter adhering to, or mixed into, food products. Below is an example of the qualitative analysis of a metal fragment on chocolate.
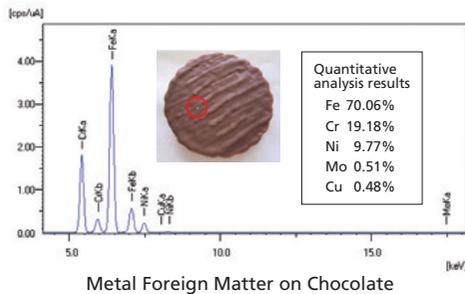
Metal Foreign Matter on Chocolate

Analysis of Organic Foreign Matter (FTIR)

The Fourier transform infrared (FTIR) spectrophotometer measures the organic foreign matter spectrum and compares it with library data to identify the foreign matter. The example below shows the analysis of contamination on a frozen pizza. Some of the foreign substance was scraped off the frozen pizza, and the infrared spectrum was measured using a transmission infrared microscope. The spectrum of this foreign object was similar to that of a fluororesin.
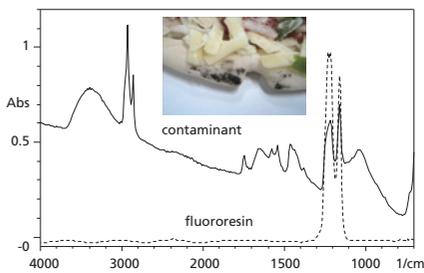
Infrared Spectra of Contaminant and Fluororesin

EDXIR-Analysis software is specially designed to perform an integrated analysis of data from FTIR and EDX. The library used for data analysis (containing 485 data as standard) is original to Shimadzu.

Energy Dispersive X-ray Fluorescence Spectrometer EDX-7000/8000/8100

Features

Large Sample Chamber
Accepts samples of up W300 x D275 x H100 mm.

Easy Operation
Automates complex set-up operations. Even novices can easily conduct accurate measurements.

IRTracer-100 FTIR Spectrophotometer

Features

High Sensitivity
High S/N ratio above 60,000:1. Microscope permits analysis of foreign matter in the micron size range.

Foreign Matter Analysis Program as Standard
Powerful support for foreign matter analysis. Includes more than 300 spectra of recognized foreign matter.

Easy Maintenance
Automatic dryer protects the optical system. Eliminates superfluous maintenance.

Software for Integrated Analysis of EDX and FTIR Data (EDXIR-Analysis)

EDX Data

FTIR Data
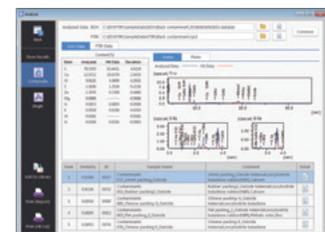
Integrated Data Analysis of Foreign Matter

Prevention of Defects in Packaging

Testing the strength and functionality of packaging materials is essential to ensure food products reach consumers fresh and undamaged. To aid the development and quality control testing of packaging materials, Shimadzu analytical and testing technologies allow the analysis of residual solvents in packaging materials, strength testing of adhesive seals, and checking of pin holes in packaged products.

Adhesive Strength Testing (Strength Tester)

A wide range of materials, including aluminum and other metals and non-metallic materials such as paper and plastic, is used for packaging. According to their application, these materials must meet certain tensile, compression, and bending strength requirements, and if an adhesive is used, adhesive strength requirements. In the examples below, adhesive strength results for liquid-filled pouch and dry snack package specimens are shown. In both instances, the adhesives meet the requirements of being strong enough to protect the contents, but weak enough so that the contents can easily be accessed by consumers.

Liquid-filled Pouch

Dry Snack Packaging
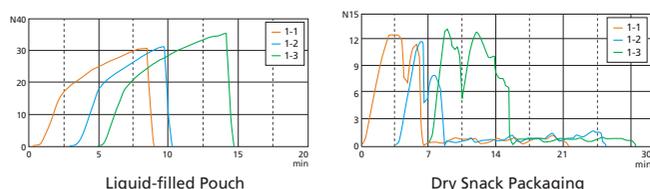
Analysis of MOSH/MOAH (LC-GC Online System)

Analysis of MOSH/MOAH (LC-GC Online System)
There's concern about the influence of mineral oil components such as MOSH (mineral oil saturated hydrocarbons) and MOAH (mineral oil aromatic hydrocarbons) on the human body. Food can get contaminated with MOSH/MOAH through contacts with packaging materials and printing colors of packaging. LC-GC online system with autosampler enables effective and high throughput analysis of MOSH and MOAH in food and food packaging. After separation in HPLC, MOSH and MOAH fractions are automatically transferred to GC and detected by two FID simultaneously. It's a powerful solution for the analysis of non-intentionally added substances (NIAS) such as mineral oil hydrocarbons.

LC-GC Online System with Autosampler for MOSH/MOAH Analysis*
Nexera X2 + Nexis GC-2030 + PAL Autosampler

*Configuration may not be available in all countries. Check with your Shimadzu representative.

EZ Test Universal Testing Machines

Features

Comprehensive Range of Jigs
Diverse strength testing: peeling, tensile, shear, bending, compression, etc.

Measures Brittle and Elastic Samples
5 kN max. capacity, 920 mm stroke (long-type).

Food Texture Evaluation
Objective testing which analyzes the consistency and mouth feel of foods.
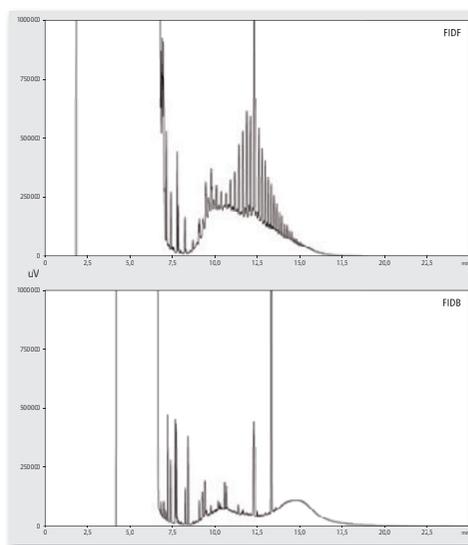
Chromatogram of MOSH/MOAH in Food and Food Packaging

Source: AOAC 2017 Poster No. P-W-021

Shimadzu's Total Support for Food Safety

Halal Testing

The unauthorized blending of undeclared materials into food products has become a major concern among consumers. Such action violates customer rights based upon economical and safety values and it is also a critical problem for communities with ethical and religious beliefs. Shown below are the results from an analysis using a high-sensitivity LC-MS/MS method for ensuring halal food integrity by targeting more heat-stable porcine-specific peptide markers in processed food.

Peptide Marker	Spiking Percentage of Cooked Pork (%, wt) [n=4]			
	0.1	0.5	1.0	5.0
YDII	+	+	+	+
LVVI	+	+	+	+
EVTE	ND	ND	ND	+
TVLG	ND	ND	ND	ND
FVIE	ND	+	+	+
TLAF	ND	ND	+	+
SALA	+	+	+	+

Peptide Candidate Selection → FASTA format download via UniProt Database → MRM Prediction via Skyline → Method Development & Analysis
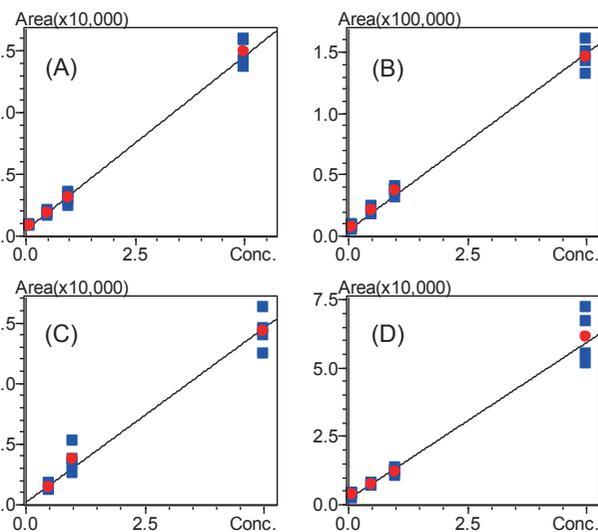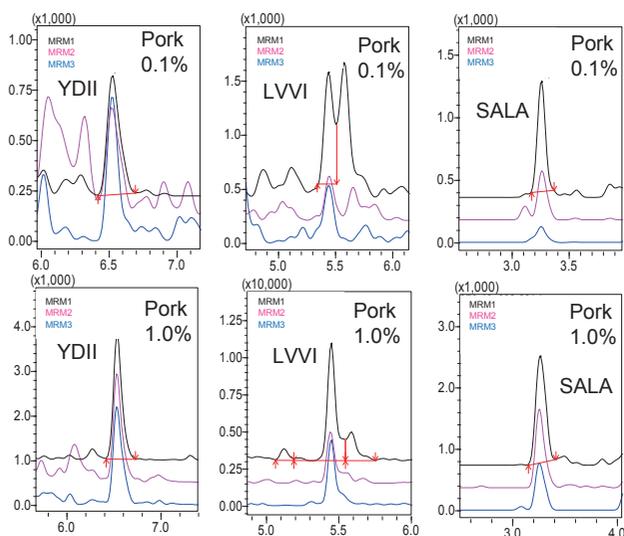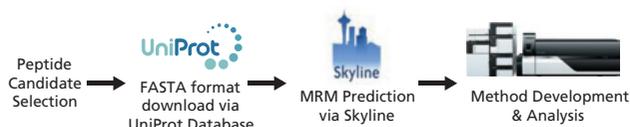
Source: Shimadzu Application News No. AD-0153

In summary, the established MRM-based method on a LC-MS/MS platform offers a highly sensitive and selective approach to detect and monitor the presence of porcine-specific markers for semi-quantitation of the amount of pork in processed foods. The established method from sample preparation to LC-MS/MS analysis exhibits excellent reliable sensitivity, and is potentially able to support halal testing in processed food products. Analysis of various food matrices will be performed in the future.

Laboratory Data Management

The increased demand for food safety analysis and measurement has led to a dramatic increase in the number of samples being analyzed which, in turn, has resulted in demands for faster, easier-to-use instruments and software. With this background, faster, more efficient management of instruments and data is essential. LabSolutions is a network-compatible analysis data system capable of meeting these needs.

LabSolutions CS – Total Laboratory Network

Freely Accessible to the Analysis Network

Since all analytical data is managed in the database of a server computer, LabSolutions CS can read data from any personal computer on a network. In addition, analysis directions and instrument monitoring and control can be performed from a personal computer (client PC) not connected to the instruments.

Moreover, client PC functions are performed on a server and client PCs corresponding to a Windows terminal service do not need to install LabSolutions software.

Recommended for the following customers

- Facilities with a large number of instruments and users
- Facilities interested in enhancing procedural efficiency
- Facilities interested in enhancing managerial efficiency
- Facilities where existing PCs can be used as client PCs

LabSolutions server

Client PC

Analysis equipment room or an office

Acquisition controller PC

UV   FTIR   RF   ICPMS

LC   GC   LC   GC

GCMS   AA   TOC

EDX   Particle size analyzer

Combine with a Multi Data Registration license to enable integrated management of these instruments' data.

Shimadzu's Total Support for Food Safety
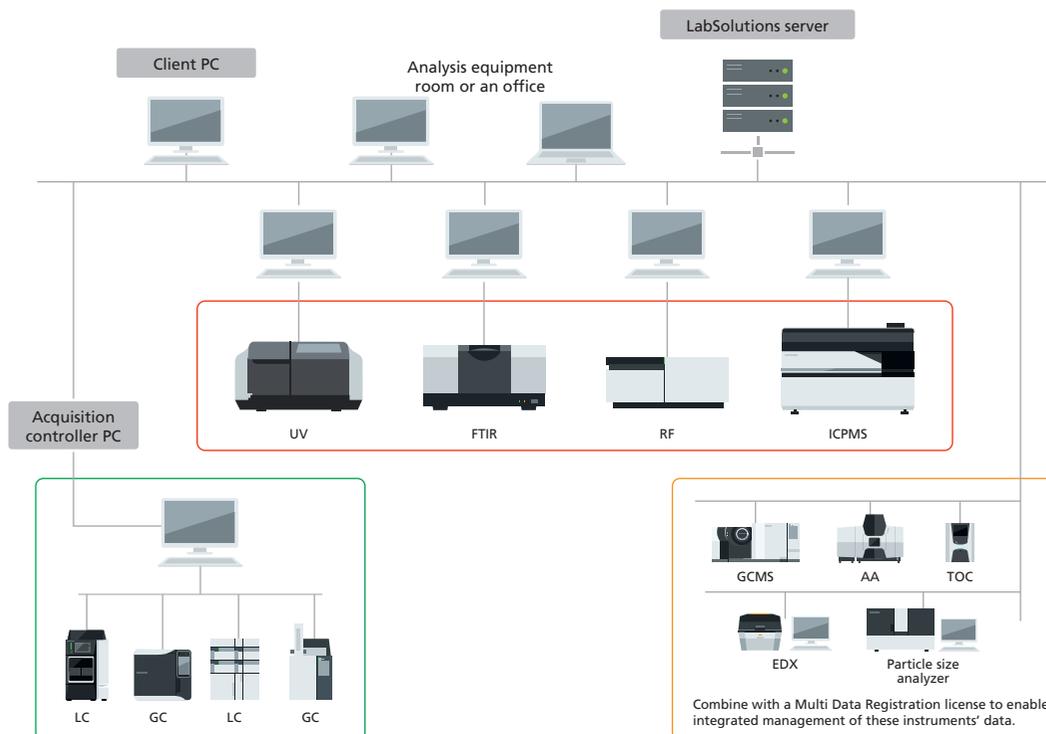
List of Analytical and Testing Instruments for Food Safety

	Residual Pesticides	Veterinary Pharmaceuticals	Bacteria	Mycotoxins	Food Additives	Toxic Metals	Inspection and Analysis of Foreign Matter	Off-Flavor	Allergens	Prevention of Defects in Packaging	Region and Type Identification
Gas Chromatograph (GC)	○				○			○		○	
Gas Chromatograph Mass spectrometer (GC-MS)	○				○			○		○	
Liquid Chromatograph (LC)	○	○		○	○	○			○		
Liquid Chromatograph Mass spectrometer (LC-MS)	○	○		○	○				○		
MALDI-TOF Mass Spectrometer (MALDI-TOF-MS)			○								
UV-VIS Spectrophotometer (UV)					○	○					
FTIR Spectrophotometer (FTIR)							○				
Atomic Absorption Spectrophotometer (AA)						○					
ICP Emission / Spectrometer (ICP, ICP-MS)						○					○
X-Ray Fluorescence Spectrometer (XRF, EDX)						○	○				
Universal Testing Machine (AG, EZ Test)										○	

○: Applicable

Shimadzu Balances

Thanks to the built-in UniBloc AP integrated aluminum mass sensor and an optimized control system, this balance achieves high-speed measurements with a response as quick as 2 seconds. It has been designed for excellent operability, and features an easy-to-read organic EL display. The AP-W series is equipped with a function to automatically calculate the weight values required for sample concentration preparation, which supports routine weighing operations.

SHIMADZU

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