ACCURATE AND **ROBUST** **QUANTITATION** OF VITAMINS IN FOOD AND BEVERAGES

Waters
THE SCIENCE OF WHAT'S POSSIBLE.®

Deliver quality, consistent products, more cost-effectively than ever before.

Accurate and precise quantitative measurements of vitamins are critical for the manufacture of high quality and regulatory compliant food and beverage products.

Common vitamin analysis techniques are often time-consuming and only target a single vitamin per run. Manufacturers recognize the need to employ more efficient methodologies that are appropriate for a wide variety of food and beverage matrices.

Waters has pioneered the development of accurate, robust, and easy-to-use solutions for analyzing vitamins in foods, beverages, and dietary supplements.

These comprehensive systems combine the unparalleled performance of Waters® ACQUITY UPLC® with advanced mass spectrometry detection, innovative sample preparation, and industry-leading data management software, to help food and beverage manufacturers increase throughput and deliver quality, consistent products, more cost-effectively than ever before.

With fewer bottlenecks, less waste, and more information in less time, Waters vitamin analysis solutions allow you to easily transfer and validate your current methods, streamline analytical workflows, and help reduce laboratory operational costs.

Waters systematically addresses the specialized needs of vitamin analysis for food and beverage laboratories. Whatever the challenge — SPE, batch-to-batch column performance, method repeatability, data management, or system usability — we have the solution.

- **SAMPLE PREPARATION AND CONSUMABLES**
- **CONVERGENCE CHROMATOGRAPHY**
- **ULTRA PERFORMANCE LIQUID CHROMATOGRAPHY**
- **MASS SPECTROMETRY**
- **DATA MANAGEMENT**
- **WATERS GLOBAL SERVICES**

SAMPLE PREPARATION AND CONSUMABLES
OASIS SAMPLE EXTRACTION PRODUCTS

Efficient, cost-effective sample preparation for optimized laboratory performance

One of the most powerful sample preparation techniques is solid-phase extraction, or SPE. Waters Corporation is a pioneer in this area and provides a variety of industry leading products, applications, and technical expertise to our food industry partners. Featuring the Oasis® sample extraction products and SPE protocols, Waters food testing sample preparation products and consumables provide the sensitivity, simplicity, and speed that today's food and beverage laboratories require.

KEY FEATURES/BENEFITS

- Provides simple, rapid, and selective methods for extracting vitamins from fortified food products.

- Revolutionary polymeric and silica-based SPE sorbents.

- Wide variety of formats including cartridges, plates, and on-line columns.

- Complete flexibility for method development.

- Faster protocols allow reduced time for vitamin extraction.

CONVERGENCE CHROMATOGRAPHY

ACQUITY UPC^2 SYSTEM

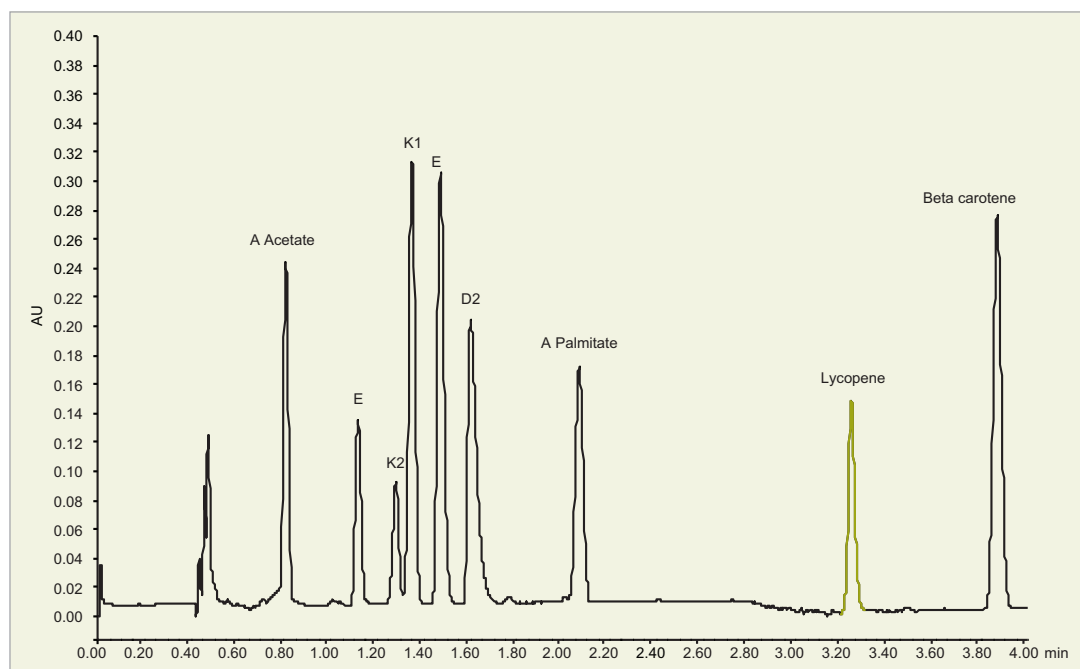# Faster, more cost-effective, and sustainable vitamin analysis

ACQUITY UltraPerformance Convergence Chromatography™ (UPC^2®) streamlines vitamin analysis by allowing labs to use a single technique on a single system to analyze a wide range of analytes.

KEY FEATURES/BENEFITS

- ACQUITY UPC^2™ provides improved speed, resolution, reliability, and flexibility compared to normal phase LC, and reversed phase LC for vitamin analyses.

- Leverages the unique properties of supercritical carbon dioxide (CO_2) that provides a more cost-effective, sustainable, and greener technology alternative by lowering the use of organic solvents.

- Reduce the number of assays for laboratories routinely performing multiple fat-soluble vitamin analyses. Eliminates the need for multiple methods typically required by HPLC.

- ACQUITY UPC^2 Columns have excellent lifetimes, provide superior peak shape, and offer a wide range of selectivities.

ACQUITY UltraPerformance Convergence Chromatography (UPC^2) System.

With ACQUITY UPC^2 the separation and analysis of seven fat soluble vitamins and two carotenoids can be achieved with a four-minute runtime.

ULTRAPERFORMANCE LIQUID CHROMATOGRAPHY

ACQUITY UPLC H-CLASS SYSTEM WITH ACQUITY QDa, PDA, AND FLR DETECTORS

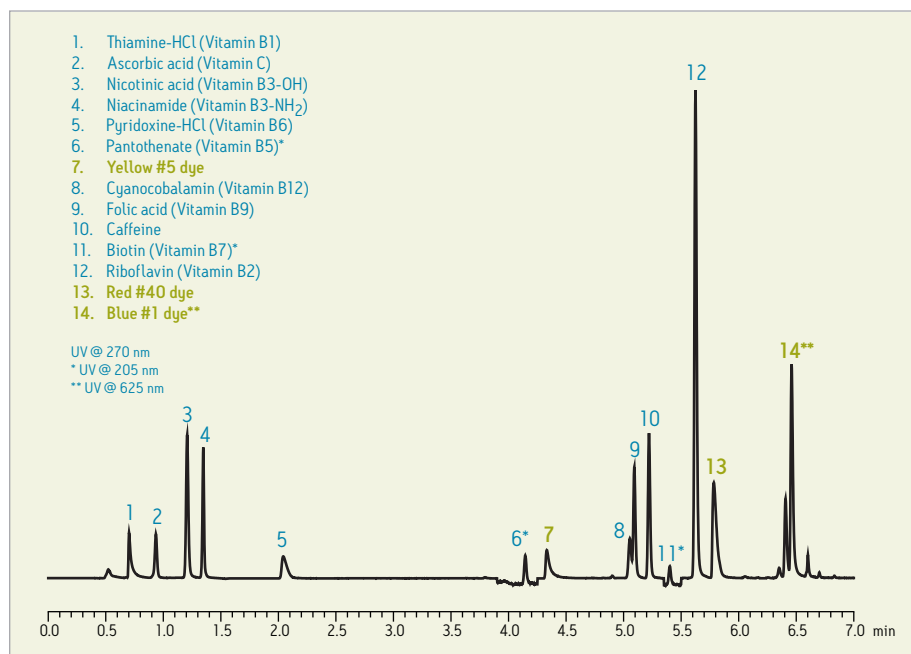# HPLC familiarity with UPLC performance

Allows you to easily update traditional HPLC procedures by reducing multi-analyte analysis times by up to 10-fold, while improving sensitivity, resolution, and method robustness.

KEY FEATURES/BENEFITS

■ Rapidly transfer analysis methods from multiple HPLCs to one UPLC® System.

■ The ACQUITY UPLC PDA and FLR detectors provide fast data acquisition capabilities for rapid analyses and the sensitivity required for trace impurity detection and quantification.

■ Sensitivity, robust performance, easy upkeep, and intuitive operation for any expertise level with the ACQUITY® QDa Detector.

■ Reduce solvent consumption for LC analyses by up to 95%, saving on both acquisition and disposal costs.

■ ACQUITY UPLC columns provide unprecedented peak symmetry, efficiency, and chemical stability.

■ Generate certificates of analyses (COAs) more rapidly to ensure products are delivered to market as quickly as possible.

ACQUITY UPLC H-Class System with ACQUITY QDa Detector.

1. Thiamine-HCl (Vitamin B1)
2. Ascorbic acid (Vitamin C)
3. Nicotinic acid (Vitamin B3-OH)
4. Niacinamide (Vitamin B3-NH_2)
5. Pyridoxine-HCl (Vitamin B6)
6. Pantothenate (Vitamin B5)*
7. **Yellow #5 dye**
8. Cyanocobalamin (Vitamin B12)
9. Folic acid (Vitamin B9)
10. Caffeine
11. Biotin (Vitamin B7)*
12. Riboflavin (Vitamin B2)
13. **Red #40 dye**
14. **Blue #1 dye****

UV @ 270 nm
* UV @ 205 nm
** UV @ 625 nm

Separation of 10 water soluble vitamins, caffeine, and three food dyes in less than seven minutes with the ACQUITY UPLC H-Class System.

Generate high-quality mass spectral data at the push of a button

With the ACQUITY QDa Detector, you now have information-rich mass spectral data to complement data from your current Waters optical detectors. This mass spectral information integrates seamlessly into the same workflow, routinely giving you more complete separation characterization.

ACQUITY QDa Detector.

KEY FEATURES/BENEFITS

- Extend the sample detection ability of your PDA detector to quantify compounds with no UV response at levels not amenable to or accessible by optical detection.

- It's as intuitive as an optical detector with the robustness to handle all of your analyses.

- Any analytical scientist can consistently generate the highest quality mass spectral data routinely — no special training or expertise required.

- The only mass detector that integrates with and even fits on top of your instrument stack.

- Compatible with all of Waters ACQUITY UPLC, ACQUITY UPC,[2] Alliance® HPLC, and purification LC and SFC systems.

- Fully compatible with Empower® Chromatography Software as well as MassLynx Mass Spectrometry Software and its suite of data processing application managers.

MASS SPECTROMETRY

ACQUITY UPLC H-CLASS SYSTEM WITH XEVO TQD

Increased sensitivity and selectivity for routine analysis

Accessible UPLC/MS/MS applications for routine quantitative analyses that reduces complexity, increases ease-of-use, and maximizes productivity.

ACQUITY UPLC H-Class System with Xevo TQD.

KEY FEATURES/BENEFITS

- IntelliStart™ Software simplifies MS setup and routine operation with automated quantification workflow tools that minimize variability between different operators, departments, and laboratories.

- Observe MRM (multiple reaction monitoring) data and full scan background data simultaneously for faster, more robust method development.

- RADAR™ Technology provides the sensitivity and selectivity to monitor for matrix interferences, metabolites, impurities, and degradants in samples while accurately quantifying target compounds.

- Universal ion source architecture provides the most extensive range of interface capabilities available.

- Ready-to-use UPLC/MS methods for the analysis of water and fat soluble vitamins within the Quanpedia™ compound database.

ACQUITY UPLC I-CLASS SYSTEM WITH XEVO TQ-S

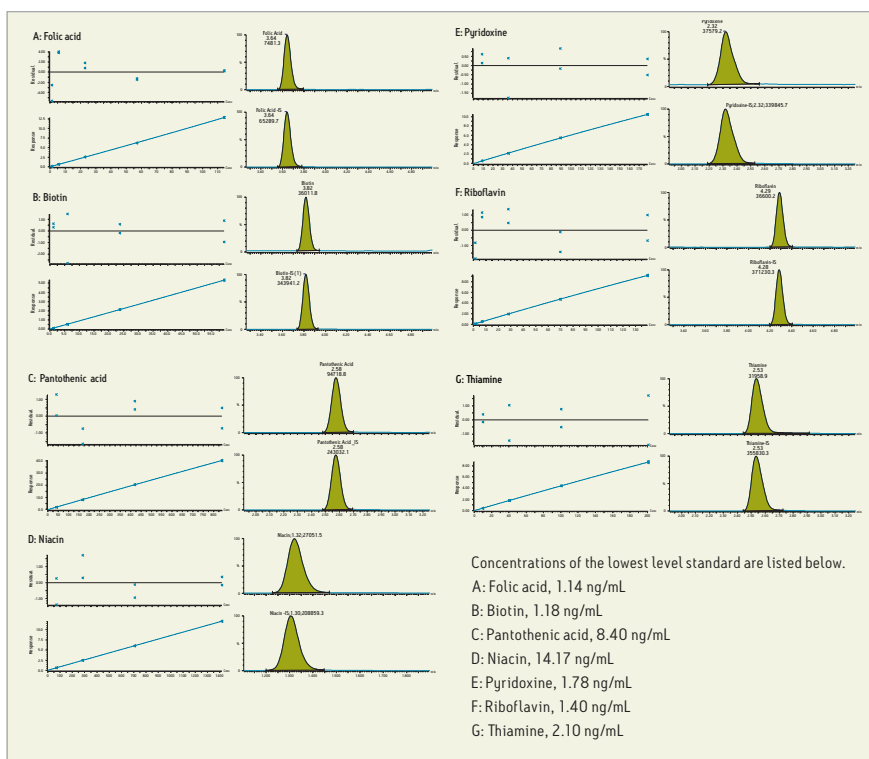# Delivers the ultimate sensitivity in LC/MS/MS performance

Allows for the analysis of multiple analytes and very complex food and beverage matrices, where the highest levels of sensitivity, selectivity, speed, and accuracy are required.

ACQUITY UPLC I-Class System with Xevo TQ-S.

KEY FEATURES/BENEFITS

- StepWave™ ion guide: a revolutionary new off-axis, ion-source technology, delivers the ultimate LC/MS/MS performance of any available tandem quadrupole system.

- ScanWave™ technology, a novel patented collision cell design, allows scientists to get both the very best quantitative data as well as superior MS/MS spectral information.

- Streamline analysis of vitamins with the use of multi-analyte methods.

- Easily detect the presence of vitamins found at vastly differing concentrations, such as Vitamin C at high levels and Vitamin B12 at extremely low levels, in the most challenging matrices.

- Perform inter and intra batch comparisons to monitor manufacturing processes and ensure product consistency.

Concentrations of the lowest level standard are listed below.
A: Folic acid, 1.14 ng/mL
B: Biotin, 1.18 ng/mL
C: Pantothenic acid, 8.40 ng/mL
D: Niacin, 14.17 ng/mL
E: Pyridoxine, 1.78 ng/mL
F: Riboflavin, 1.40 ng/mL
G: Thiamine, 2.10 ng/mL

Quantification of seven water soluble vitamins with the ACQUITY UPLC and Xevo TQ-S System. Calibration curves and residuals plots along with the MRM chromatograms of the lowest level standard and internal standard of each vitamin are shown.

WATERS LABORATORY INFORMATICS SOFTWARE

Effective data management for vitamin analysis

A powerful suite of solutions for instrument control, scientific data management, scientific search, network integration, and compliance management to streamline analytical laboratory operations. Waters Informatics solutions have helped leading food and beverage organizations reduce costs, accelerate decision making, improve laboratory effectiveness, and get products to market faster.

WATERS GLOBAL SERVICES

Be assured.
Choose Waters Global Services.
Waters Global Services focuses on optimizing Waters products with superior service, support, upgrades, training, and Waters Quality Parts.®

Proven satisfaction
For thirteen consecutive years, an independent quality auditing firm ranked Waters Global Services best-in-class in providing expert technical knowledge, quick resolution of system issues, and process support.[1]

[1] *Achievement in Customer Excellence Award, CustomerSat, Inc., 2007-2013; NorthFace ScoreBoard Award,[sm] Omega Management Group Corporation, 2001-2006.*

Empower 3 Chromatography Data Software makes it easier than ever to run samples and produce meaningful results. Empower 3's interface is designed to maximize your productivity, improving how you collect, process and print chromatography data. Grow seamlessly from a single workstation to an enterprise-wide system with Empower 3's scalable, modular architecture, which fits into the most modern, secure, HA (high availability) corporate architecture.

NuGenesis® 8 is a comprehensive data management and workflow solution that supports the entire product lifecycle from discovery through manufacturing. This user-centric platform encompasses NuGenesis SDMS, a compliant-ready data repository, and NuGenesis ELN, a flexible analytical electronic laboratory notebook. Capabilities such as sample management, laboratory inventories, data retention and legal hold, and electronic laboratory execution methods, allow NuGenesis 8 to connect the scientific data from your laboratories to the business systems of your organization more effectively than ever before.

MassLynx® Software acquires, analyzes, and distributes Waters mass spectrometry information for comprehensive instrument control and data processing. To assist with both data acquisition and the transformation of data into usable results, MassLynx Software offers easy-to-use Application Managers that allow you to focus the power of MS on your laboratory's specific tasks.

Paradigm™ Scientific Search is the next-generation of search technology for science-driven organizations — Paradigm offers a solution for accessing scientifically relevant information (chemical structures, methods, chemical reactions, chromatograms, spectra, etc.), across an organization spanning information silos, performing searches based on science objects, and adding structure to unstructured data.

"The 'Quality for Life' vision at DSM Nutritional Products focuses on developing products and partnerships where the essential values of Quality, Reliability, Traceability, and Sustainability are critical. Waters UPLC Technology and Support services align with our values, and give us the confidence that we will continue to provide the world 'Bright Science. Brighter Living,' and remain the leader in providing nutritional solutions.

I have worked with Waters Corporation for decades and found that their personnel and 'green' technology consistently support these values and help protect our 'Quality for Life' promise to the world."

TIM WELLS
Director of Quality, North America

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Waters

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