

HPLC-CAD Excipients analysis eBook

Established methods and workflows for more confident excipient analysis using charged aerosol detection



Analytical challenges

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Current challenges in excipient analysis

Pharmaceutical excipients are substances other than the pharmacologically active drug or prodrug included in the manufacturing process or contained in a finished pharmaceutical product dosage form. Due to the chemical and structural diversity, the liquid chromatographic analysis of excipients and impurities in drugs and biopharmaceutical solutions comes with several analytical challenges.

1. Inefficient separations

Excipients span a broad range of compounds, from simple ions and amino acids to highly complex materials like polysorbates, which may consist of hundreds of structurally related components. Access to efficient, reproducible columns and the capability to use gradient elution are critical considerations in method development.

2. Missing key analytes and impurities

Compounds without a chromophore are not detectable by optical detectors, and those unable to generate gas-phase ions are not identifiable by mass spectrometry (MS), the two common analytical techniques used in the pharmaceutical industry.

3. Inaccurate quantitation with gradient elution

Changes in baseline using evaporative light scattering detection (ELSD) impacts quantitative accuracy, and refractive index detection (RID) is not compatible with gradients.

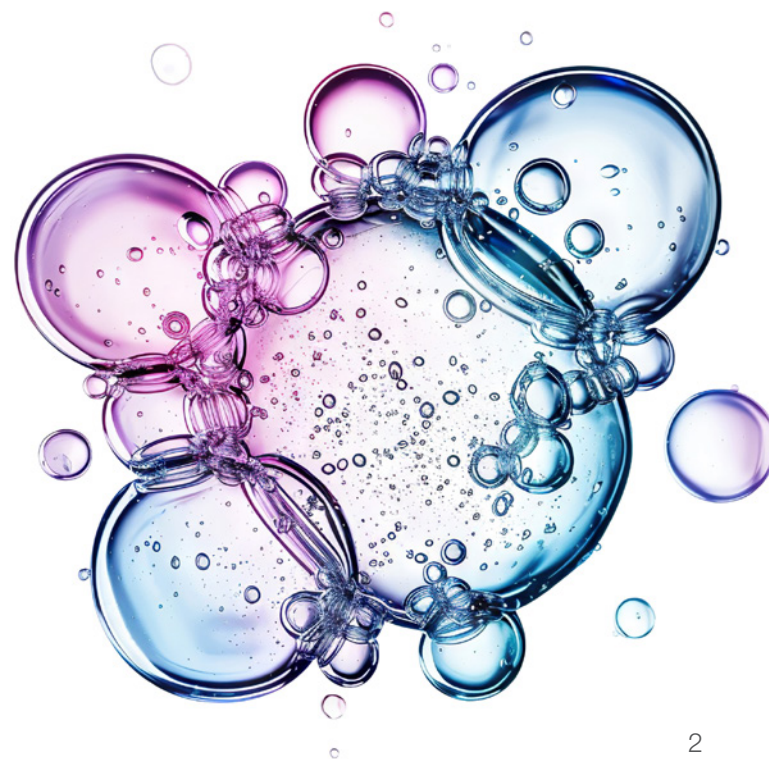
4. Standard-free quantitation

Reference standards are often not available for excipients, related substances, and impurities.

5. Poor analytical sensitivity

The charged aerosol detector (CAD) is well-suited for impurity profiling, where trace-level impurities—often below 0.1% of the API peak—must be quantified. In contrast, ELSD lacks sufficient sensitivity.

This eBook contains a summary of methods and workflows demonstrating how high-performance liquid chromatography (HPLC) combined with the CAD can meet the analytical needs of scientists working with excipients, active pharmaceutical ingredients, and impurity analysis.



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The use of excipients in modern medicine

The word excipient originates from the Latin *excipere*, which means to receive (i.e., the excipient receives the active substance).

The European Pharmacopoeia (Ph. Eur.) states: “An excipient is any component, other than the active substance(s), present in a medicinal product or used in the manufacture of the product.”

Excipients include substances that facilitate powder flowability or non-stick properties during manufacturing. In the drug product, they may act as bulking agents, fillers, or diluents, or are used to enhance drug absorption, reduce viscosity, enhance solubility, or prevent denaturation or aggregation over the expected shelf life.

Other excipients, such as sweeteners, modify the taste of a medicine and contribute to improving patient compliance.

Colors enable the identification of medicines and help to decrease the risk of patients mistaking one product for another. [Lipid nanoparticles \(LNP\)](#) and [liposomes](#) help facilitate the delivery of drugs into cells.

The selection of appropriate excipients also depends on the route of administration, dosage form, active ingredients, and other factors. Vaccines, in addition to weakened or killed disease antigens, also contain very small amounts of an excipient called an [adjuvant](#). This excipient helps promote the effectiveness of a vaccine by reducing the amount or frequency of the required dose, by prolonging the duration of immunological memory, or by modulating the involvement of humoral or cellular responses.



Excipient function

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Drug delivery, solubility, and formulation stability

The intended function of an excipient is to guarantee the required physicochemical and biopharmaceutical properties of the pharmaceutical preparation. Excipients play a number of roles including:

- [Adjuvant](#)
- Aerosol propellants
- Antifoaming
- Antimicrobial preservatives
- Antioxidants
- Binders
- [Biosurfactants](#)
- Bulking agent (freeze-drying)
- Chelating/sequestering agents
- Coating agents
- Colorings, flavors, perfumes
- [Counterions](#)
- Diluents
- Disintegrants
- Drug delivery
- Emulsifying/solubilizing/wetting agents
- Glidant, anticaking agents
- [Lubricants \(e.g., silicone oils\)](#)
- Ointment/suppository base
- Powder flowability or non-stick properties
- [Surfactants](#)
- Suspending/viscosity-increasing agents
- Sweetening agents
- Tonicity agents
- Vehicles
- Viscosity control



Introducing the charged aerosol detector

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Near-universal detection – solving the analyte detection challenge

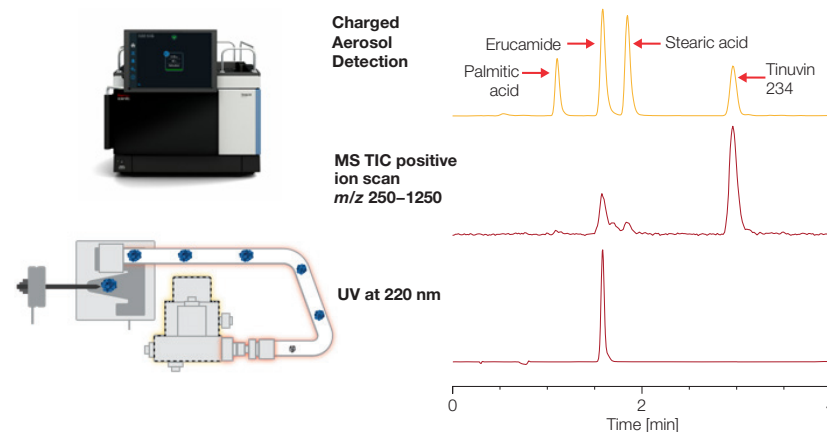
Often, one analyte class responds more strongly to one detection method than another or may not respond at all. What is most desired is a **near-universal solution** capable of detecting a wide range of analytes with a uniform response that facilitates accurate quantitation.

Charged aerosol detection is a reliable technology that will change the way you "see" every sample. This near-universal detector can detect all non-volatiles—with a uniform response—and many semi-volatile analytes in a single solution.

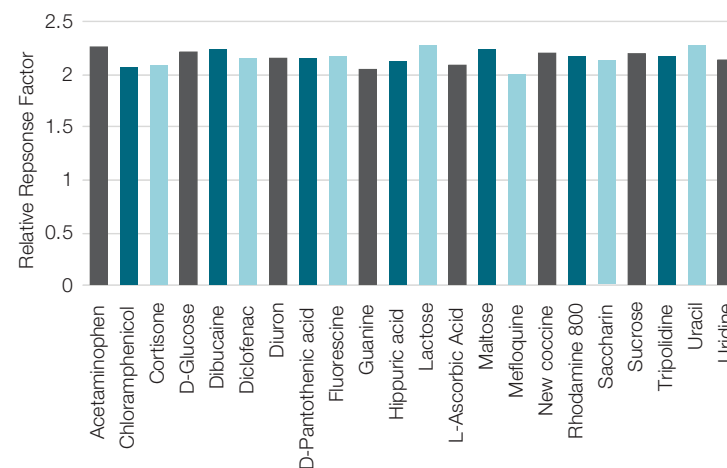
The **CAD** gives a consistent and uniform response, which supports the quantification of multiple analytes using a single calibrant—an ideal solution for determining unknown impurity levels, particularly when reference standards are unavailable or cost-prohibitive.

By delivering the accuracy required for R&D and the reproducibility essential for manufacturing QA/QC, every sample is analyzed with confidence and clarity.

This analytical versatility **makes the CAD well-suited for excipient analysis.**



Near-universal detection



Uniform analyte response

How the CAD works

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Measures particle charge, not light-scattering ability or mass-charge ratio

Charged aerosol detection works by detecting charged analyte particles. The response is independent of chemical structure.

Three simple steps to charged aerosol detection

1. Nebulization

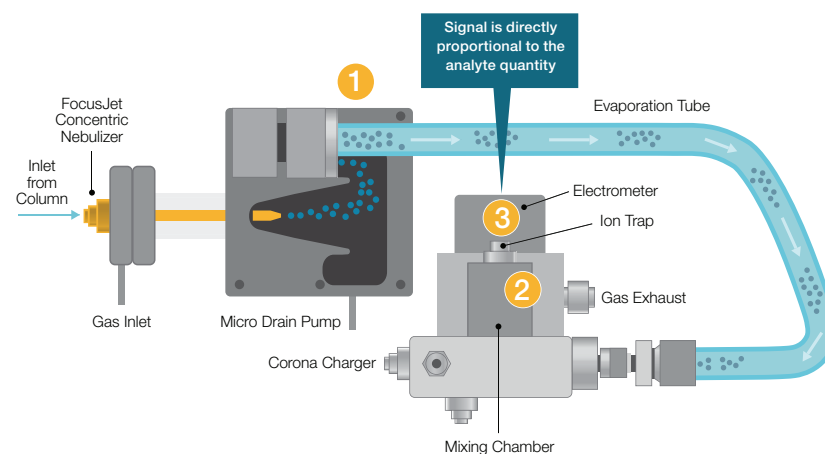
The eluent is nebulized into droplets, which are subsequently heated and then dried into particles. The particle size increases with the amount of analyte.

2. Charging

A stream of charged nitrogen gas collides with the analyte particles, producing positively charged analyte particles.

3. Detection

The charge on the charged particles is measured by an electrometer. The signal is directly proportional to the quantity of analyte present.



Schematic of CAD technology

Learn more: thermofisher.com/CAD

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CAD performance strengths

Uniform analyte response for all non-volatiles and many semi-volatiles

Unlike mass spectrometry (MS), which requires analytes to form gas phase ions, or UV-Vis, which requires the presence of a chromophore, the CAD can measure all non-volatile and many semi-volatile analytes in the sample.

- Common excipients that lack strong chromophores, like **polysorbates** and **LNP**, are highly compatible with the CAD

Up to 10x more sensitive than other near-universal detectors

The CAD is inherently more sensitive than the ELSD, which allows you to measure trace impurities alongside concentrated actives in a single analysis.

- Dynamic range 4 orders of magnitude
- Linear range 2-3 orders of magnitude
- LOQs 1–20 ng on a column
- Detects particles ≥ 10 nm

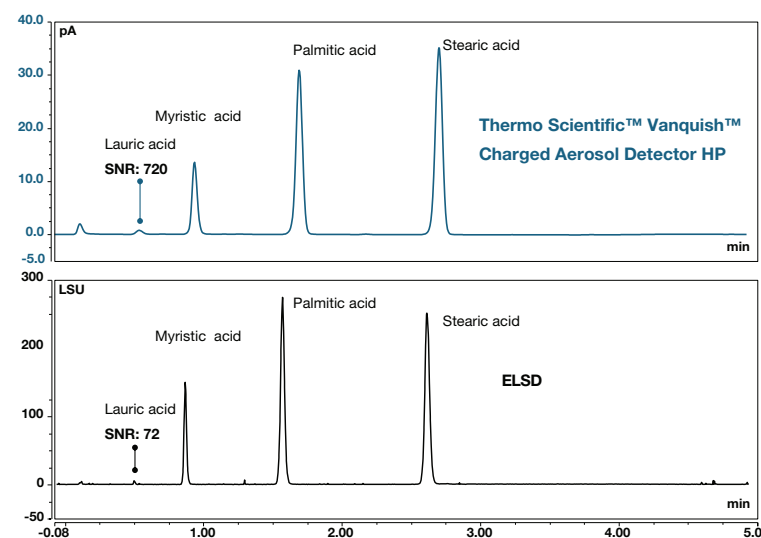
Allows standard-free quantitation of unknowns

The uniform response allows reliable single calibrant quantitation of unknown compounds when reference standards are unavailable.

Compatible with gradient elution

The CAD is fully compatible with gradient elution (RID is not). Applying an inverse gradient helps minimize changes in the CAD response across the gradient.

Learn more: thermofisher.com/CADbenefits



CAD is more sensitive than ELSD.

Performance overview of the CAD vs. other HPLC detectors

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	CAD	ELSD	RID	Single quadrupole mass spectrometer
Analyte response	Non-volatiles and some semivolatiles. Independent of analyte properties.	Non-volatiles and some semivolatiles. Dependent on analyte properties.	Universal	Only for non-volatile analytes that can form gas phase ions.
Response curve	Non-linear - Curvilinear	Non-linear - Sigmoidal	Linear	Non-linear
Sensitivity	High (<1 ng)	Moderate (>10 ng)	Low (>1 µg)	High for ionizable compounds (<1ng)
Dynamic range	Wide	Narrow	Wide	Wide
Linear range	Narrow (2–3 orders of magnitude)	Very narrow (0.5–1.0 order of magnitude)	Wide (3–4 orders of magnitude)	Narrow (2–3 orders of magnitude)
Gradient	Yes	Yes	No	Yes
Baseline stability	High	Moderate. Spiking can be an issue.	Critical. Sensitive to temperature, pressure, and composition changes.	Good. Affected by matrix, contamination, and source conditions.
Ease of use	Simple	Can be complex	Simple	Can be complex

Learn more: thermofisher.com/hplcdetectors

Adjuvants



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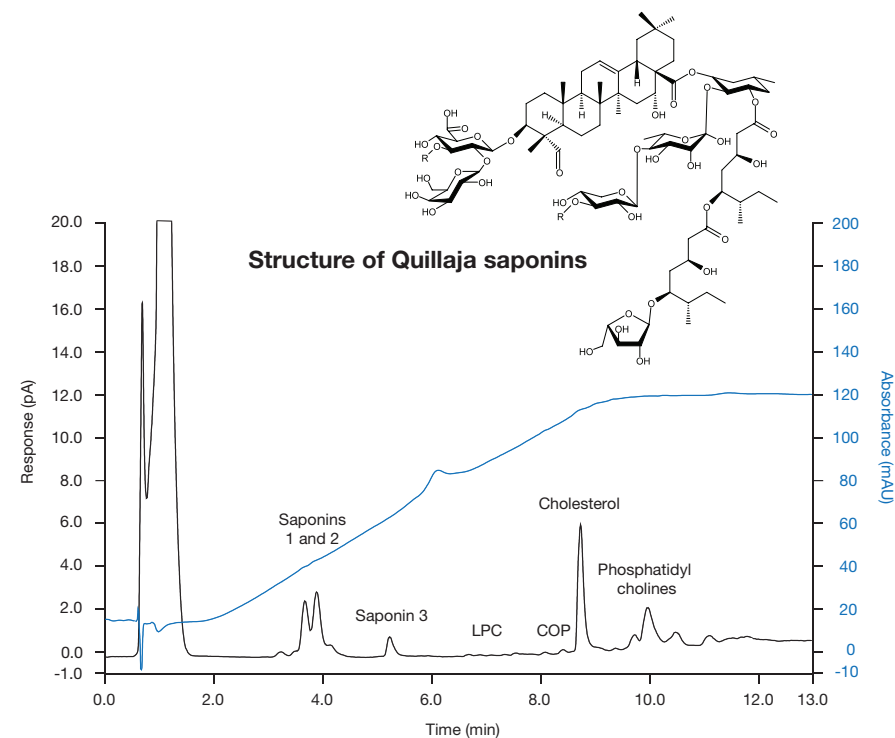
Thermo Scientific references

Thermo Scientific columns used

This commercial example consisted of purified saponins from *Quillaja saponaria*, cholesterol from sheep wool and egg phosphatidyl cholines (PCs) in phosphate buffered saline.

HPLC column	Thermo Scientific™ Hypersil GOLD™ PFP, 1.9 μ m, 2.1 x 100 mm
Mobile phase A	0.1% Formic acid in DI water
Mobile phase B	0.1% Formic acid in 10:90 acetonitrile:ethanol
Column temperature	45 °C
Flow rate	0.47 mL/min
Gradient	See poster note
Injection volume	10 μ L
Detectors	CAD and UV

CAD simultaneously measures all major components and several degradants in a commercial formulation



All components and several degradation products, including cholesterol oxidation products (COP) and lyso-PC (LPC), were detected in the formulation by CAD, but showed limited response by UV detection.

See poster note: [Direct analysis of multicomponent adjuvants by HPLC with charged aerosol detection](#)

Adjuvants – Addavax™ adjuvant

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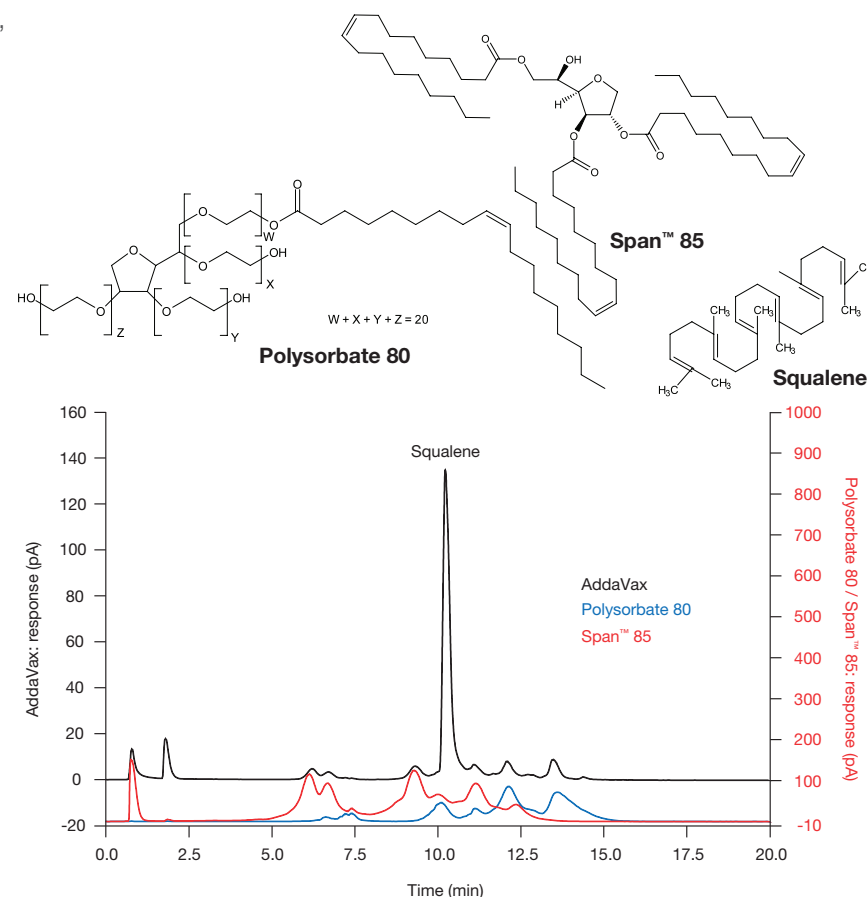
Thermo Scientific references

Thermo Scientific columns used

AddaVax adjuvant is prepared by emulsification of sorbitan trioleate (SPAN™ 85) in squalene oil (5% v/v) and polysorbate 80 (0.5% w/v), in sodium citrate buffer (10 mM, pH 6.5).

HPLC column	Thermo Scientific™ Accucore™ C8, 2.6 µm, 4.6 x 150 mm
Mobile phase A	1 mM Ammonium acetate in DI water
Mobile phase B	Isopropanol
Column temperature	40 °C
Flow rate	0.8 mL/min
Gradient	See poster note
Injection volume	10 µL
Detectors	CAD

Simultaneously measures an adjuvant and surfactants in a commercial formulation



See poster note: [Direct analysis of multicomponent adjuvants by HPLC with charged aerosol detection](#)

AddaVax was diluted 10-fold with water prior to analysis by HPLC-CAD. Chromatograms for other AddaVax components are also shown.

Adjuvants – sMPLA

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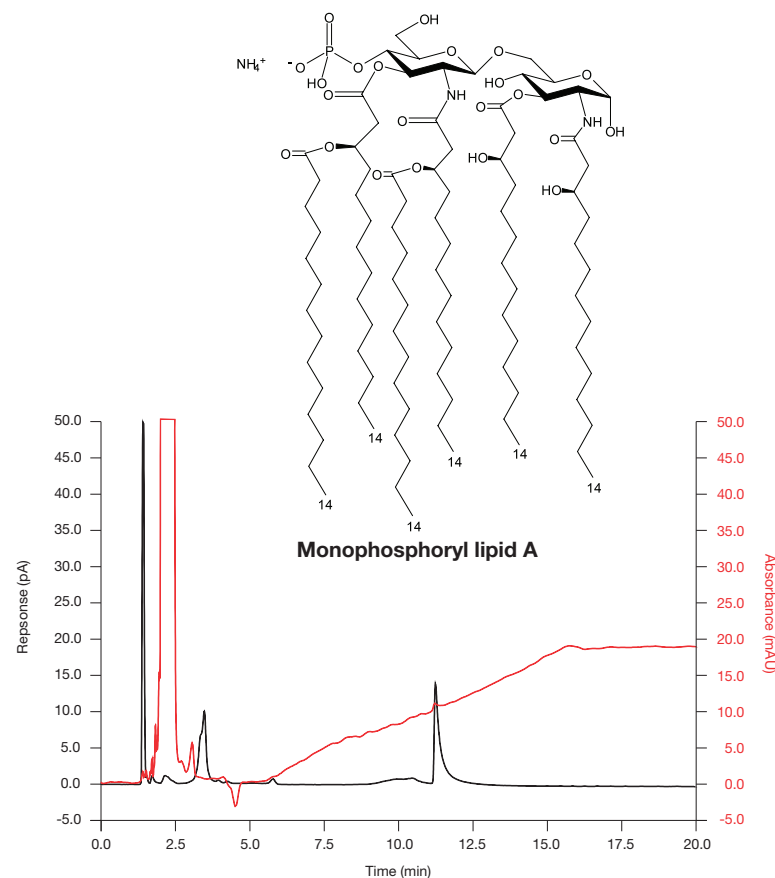
Thermo Scientific references

Thermo Scientific
columns used

Synthetic monophosphoryl lipid A (sMPLA), a hexa-acyl analog of bacterial lipopolysaccharide, has low toxicity while specifically activating toll-like receptor 4 (TLR4) but not TLR2. Purity analysis is used to quantify contaminants, degradation products, and variants differing in acyl chain number, length, and phosphorylation.

HPLC column	Accucore C8, 2.6 μ m, 4.6 x 150 mm
Mobile phase A	1 mM Ammonium acetate in DI water
Mobile phase B	Isopropanol
Column temperature	40 °C
Flow rate	0.8 mL/min
Gradient	See poster note
Injection volume	10 μ L
Detectors	CAD and UV

Purity analysis



See poster note: [Direct analysis of multicomponent adjuvants by HPLC with charged aerosol detection](#)

Purity analysis of sMPLA by HPLC-UV-charged aerosol detection.
sMPLA was dissolved in chloroform:methanol:water 80:20:4 at a concentration of ~1 mg/mL prior to analysis. (Black trace – CAD; red trace – UV).

Amino acids

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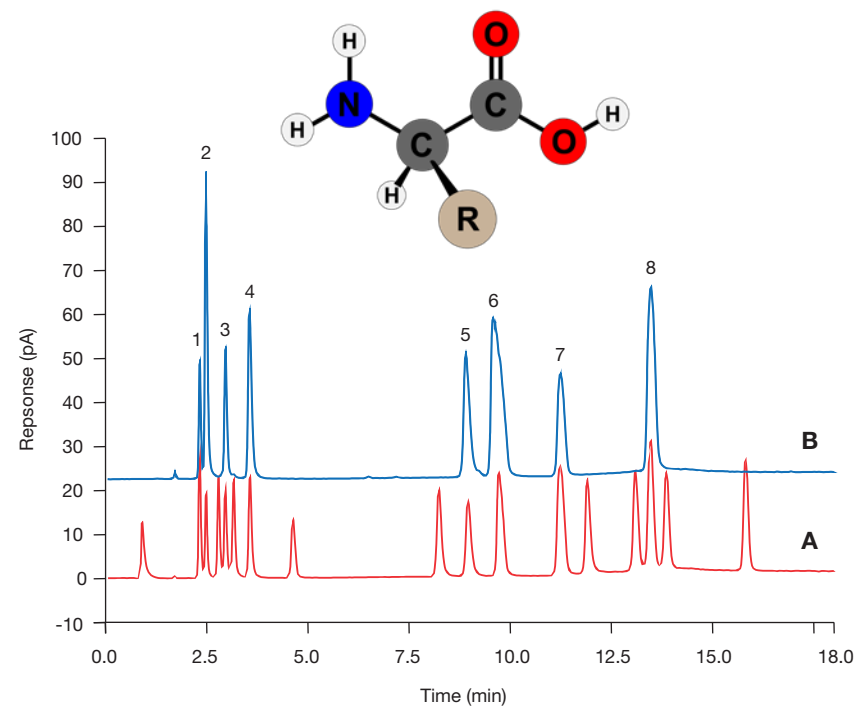
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Thermo Scientific
columns used

HPLC column	Thermo Scientific™ Acclaim™ PA2, 2.2 µm, 2.1 x 250 mm
Mobile phase A	0.15% Nonafluoropentanoic acid in DI water
Mobile phase B	0.2% Trifluoroacetic acid in acetonitrile
Mobile phase C	5% Acetic acid
Column temperature	40 °C
Flow rate	See poster note
Gradient	See poster note
Injection volume	10 µL
Detectors	CAD

Direct measurement of amino acids
without the need for derivatization



Direct analysis of underivatized amino acids by HPLC-CAD. A) Comprehensive amino acid standard mix. B) Amino acids typically used as excipients. 1 – Aspartate; 2 – Glycine; 3 – Glutamate; 4 – Proline; 5 – Methionine; 6 – Histidine; 7 – Lysine; 8 – Arginine.

See poster note: [Characterization of a biologic therapeutic: Reversed phase analysis of protein and excipients](#)

Carbohydrates – simple sugars



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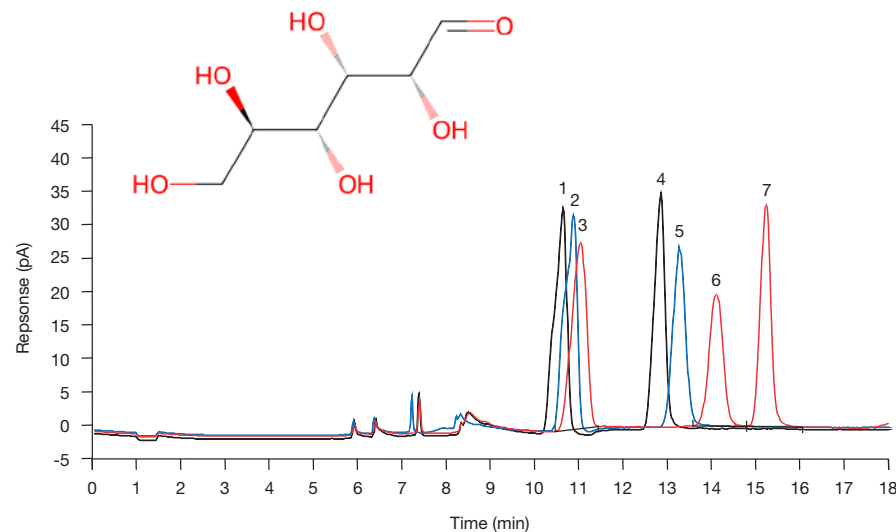
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columns used

HPLC column	HILIC
Mobile phase A	20 mM Ammonium acetate, 5% acetic acid
Mobile phase B	Methanol
Mobile phase C	Acetonitrile
Column temperature	50 °C
Flow rate	See poster note
Gradient	See poster note
Injection volume	2 µL
Detectors	CAD

**CAD is both sensitive and
gradient compatible**



Direct analysis of simple carbohydrates by HPLC-CAD. 1 – Sorbitol; 2 – Mannitol;
3 – Glucose; 4 – Sucrose; 5 – Lactose; 6 – Mannose; 7 – Trehalose.

See poster note: [Determination of proteins and carbohydrates by 2D HPLC \(RPLC and HILIC\) with charged aerosol and ultraviolet detection](#)

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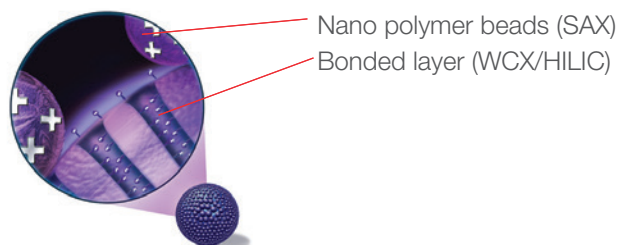
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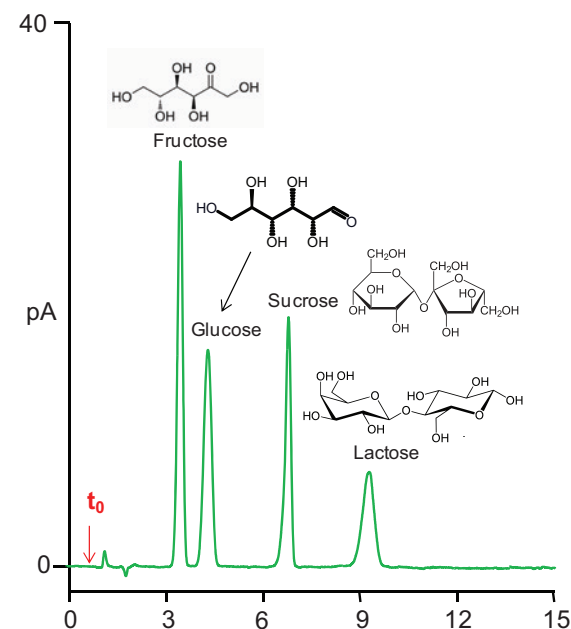
Thermo Scientific references

Thermo Scientific
columns used



HPLC column	Thermo Scientific™ Acclaim™ Trinity™ P2, 3.0 μm, 3.0 x 50 mm
Mobile phase A	Acetonitrile
Mobile phase B	100 mM Ammonium formate, pH 3.65
Column temperature	60 °C
Flow rate	0.5 mL/min
Gradient	Isocratic 80%A/20%B
Injection volume	5 μL
Detectors	CAD

A sensitive isocratic method for sugar analysis



See manual: [Acclaim Trinity P2 Column product manual](#)

Carbohydrates – cyclodextrin

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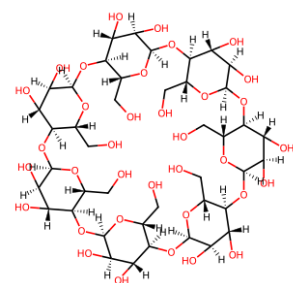
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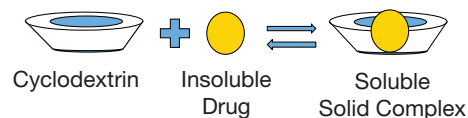
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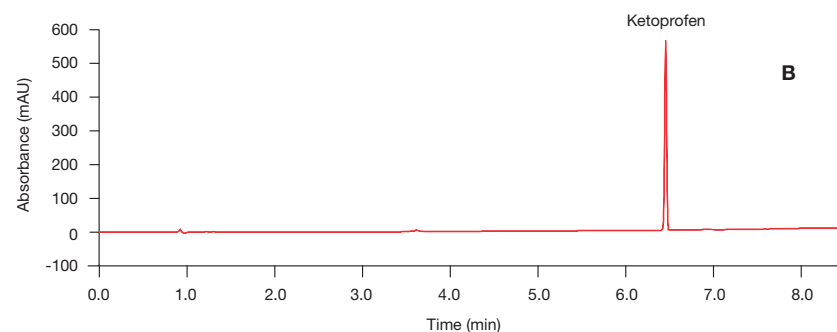
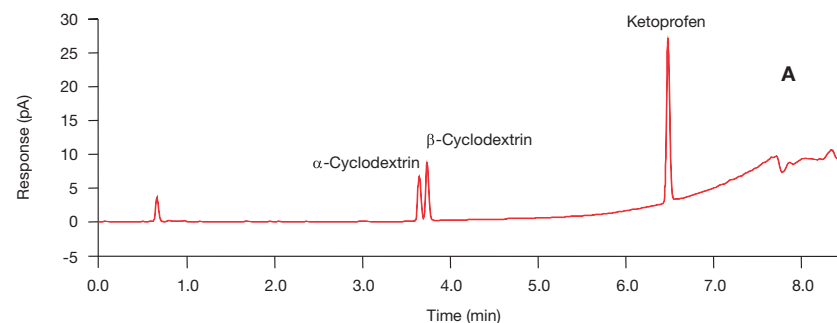
Thermo Scientific columns used



HPLC column	Acclaim PA2, 2.2 μ m, 2.1 x 250 mm
Mobile phase A	0.1% Formic acid in DI water
Mobile phase B	Acetonitrile, 0.1% formic acid
Column temperature	40 °C
Flow rate	0.5 mL/min
Gradient	See poster note
Injection volume	10 μ L
Detectors	CAD and UV



Measurement of an inclusion complex (cyclodextrin and an API).
This visibility is not possible with UV detection alone.



Analysis of cyclodextrins and ketoprofen using UHPLC with CAD (A) and UV (B).

See poster note: [Multi-modal analyte detection of cyclodextrin and ketoprofen inclusion complex using UV and CAD on an integrated UHPLC system](#)

Counterions – global method



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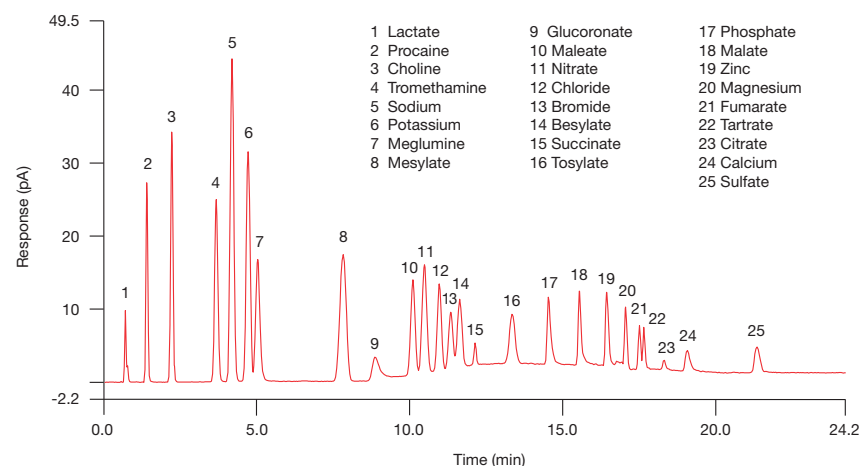
Thermo Scientific references

Thermo Scientific columns used

HPLC column	Thermo Scientific™ Acclaim™ Trinity™ P1, 3.0 µm, 3.0 x 50 mm
Mobile phase A	DI water
Mobile phase B	Acetonitrile
Mobile phase C	200 mM Ammonium formate, pH 4.0
Column temperature	35 °C
Flow rate	0.5 mL/min
Gradient	See below
Injection volume	10 µL
Detector	CAD

Time (min)	% B	% C	Gradient curve
0	60	3	5
7	60	5	4
15	5	90	7
23	5	90	5
23.1	60	3	5
28	60	3	5

Measure 25 possible counterions simultaneously



Global method for measurement of anions, cations, organic and inorganic ions simultaneously.

*This method was based on that of Zhang et al. (2010). J. Chromatogr. 1217, 5776-5784.

A similar approach can be found in: [Monitoring anions and cations in early-stage product formulation](#)

See manual: [Acclaim Trinity P1 Column product manual](#)

See poster note: [A platform method for pharmaceutical counterion analysis by HPLC](#)

Counterions – screening

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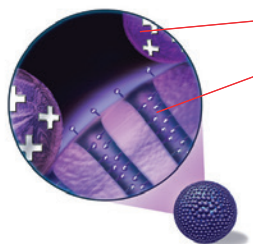
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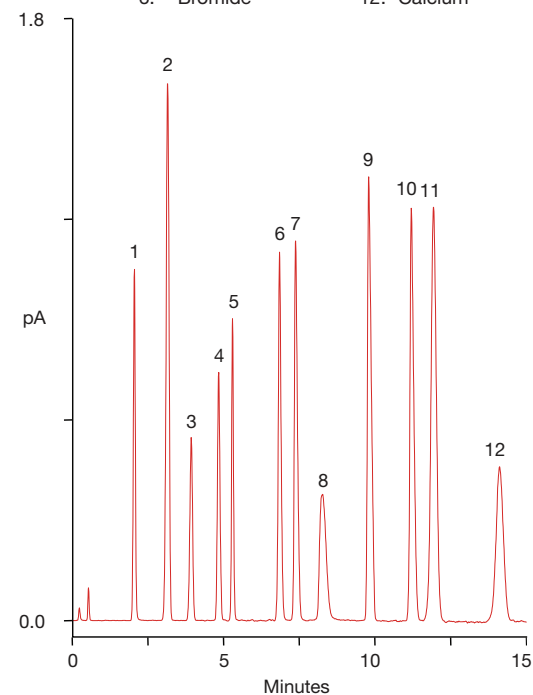
Nano polymer beads (SAX)

Bonded layer (WCX/HILIC)

HPLC column	Acclaim Trinity P2, 3.0 µm, 3.0 x 50 mm
Mobile phase A	DI water
Mobile phase B	100 mM Ammonium formate, pH 3.65
Column temperature	30 °C
Flow rate	0.6 mL/min
Gradient	See poster note
Injection volume	1 µL
Detectors	CAD

Alternative method for counterion screening

- | | |
|--------------|---------------|
| 1. Phosphate | 7. Nitrate |
| 2. Sodium | 8. Citrate |
| 3. Potassium | 9. Fumarate |
| 4. Chloride | 10. Sulfate |
| 5. Malate | 11. Magnesium |
| 6. Bromide | 12. Calcium |



See poster note: [A platform method for pharmaceutical counterion analysis by HPLC](#)

Specification sheet: [Acclaim Trinity P2 Column](#)

Counterions – API and counterion



Two examples showing the simultaneous measurement of an API and its counterion

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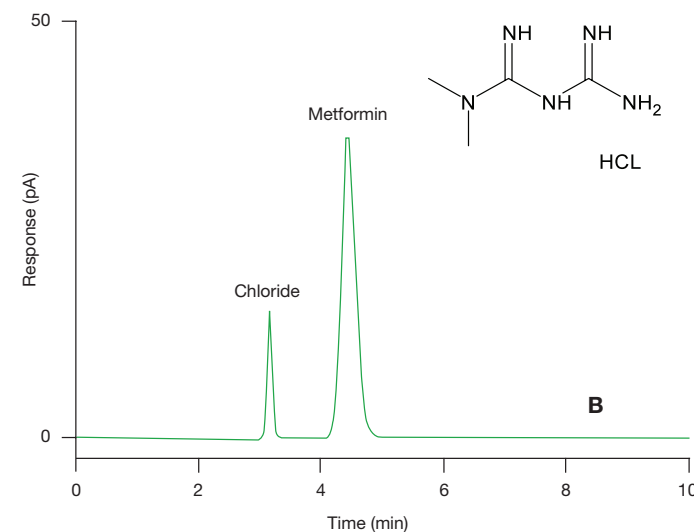
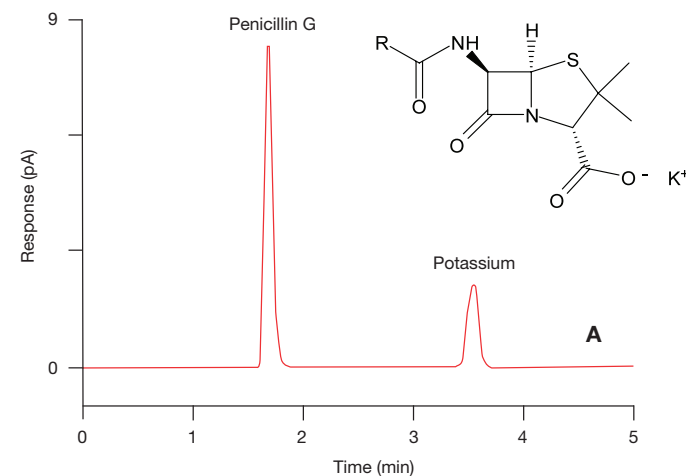
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Thermo Scientific references

Thermo Scientific columns used

HPLC column	Acclaim Trinity P2, 3.0 μ m, 3.0 x 50 mm
Mobile phase A	Acetonitrile
Mobile phase B	DI water
Mobile phase C	100 mM Ammonium formate, pH 3.65
Column temperature	30 $^{\circ}$ C
Flow rate	0.5 mL/min
Gradient	Isocratic 25:50:25, A:B:C
Injection volume	1 μ L
Detector	CAD

HPLC column	Acclaim Trinity P2, 3.0 μ m, 3.0 x 50 mm
Mobile phase A	Acetonitrile
Mobile phase B	100 mM Ammonium formate, pH 3.65
Column temperature	30 $^{\circ}$ C
Flow rate	0.5 mL/min
Gradient	Isocratic 80:20, A:B
Injection volume	1 μ L
Detector	CAD



Analysis of penicillin G potassium salt (A) and metformin chloride (B) by UHPLC-CAD.

See poster note: [A platform method for pharmaceutical counterion analysis by HPLC](#)

See manual: [Acclaim Trinity P2 Column product manual](#)

Counterions – API, counterion and trace impurity

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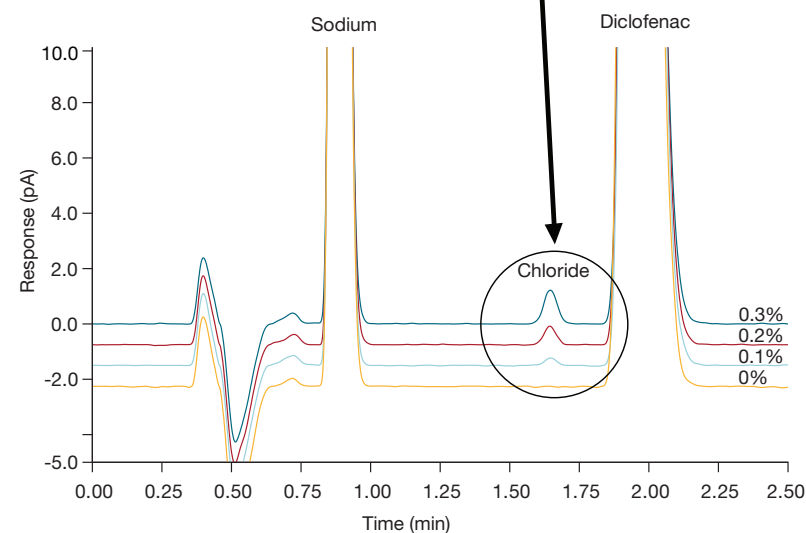
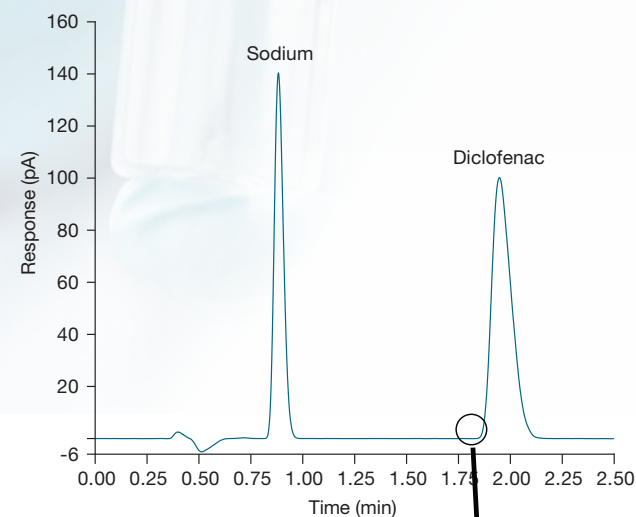
Glossary

Thermo Scientific references

Thermo Scientific columns used

HPLC column	Acclaim Trinity P1, 3.0 μ m, 3.0 x 50 mm
Mobile phase A	Acetonitrile
Mobile phase B	200 mM Ammonium acetate, pH 4.0
Column temperature	30 °C
Flow rate	0.8 mL/min
Gradient	Isocratic 70:30, A:B
Injection volume	5 μ L
Detector	CAD

Simultaneous measurement of an API, its counterion and a trace impurity at the 0.1% level



Analysis of diclofenac sodium salt (1 mg/mL) by UHPLC-CAD showing ability to measure chloride impurity at the 0.1% level (the upper chromatogram is presented at lower sensitivity).

See manual: [Acclaim Trinity P1 Column product manual](#)

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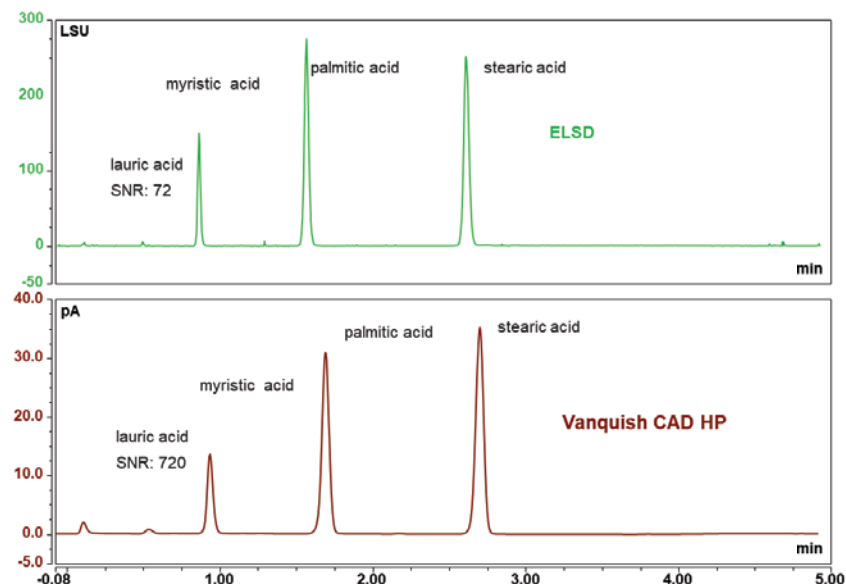
Glossary

Thermo Scientific references

Thermo Scientific columns used

HPLC column	Thermo Scientific™ Hypersil GOLD™ C18, 1.9 µm, 2.1 x 50 mm
Mobile phase A	0.05% Formic acid in DI water
Mobile phase B	0.05% Formic acid in acetonitrile
Column temperature	25 °C
Flow rate	0.75 mL/min
Gradient	See application note
Injection volume	10 µL
Detectors	CAD and ELSD

CAD is up to ten times more sensitive than ELSD



Comparison of CAD (top) and ELSD (bottom) analysis of fatty acid standard (50 µg/mL each) shows the CAD results being 10 times higher in signal-to-noise ratio (SNR) for lauric acid.

See application note: [Characterization of four saturated fatty acids using gradient HPLC-CAD highlighting optimized evaporation temperature control features](#)

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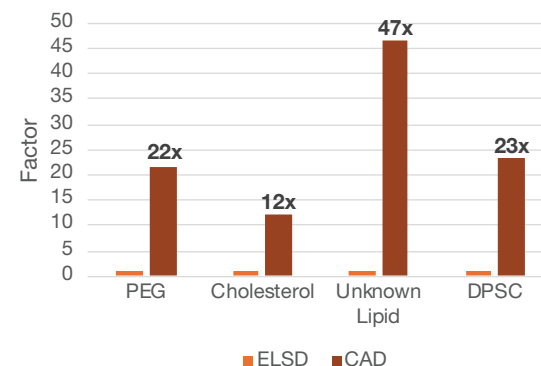
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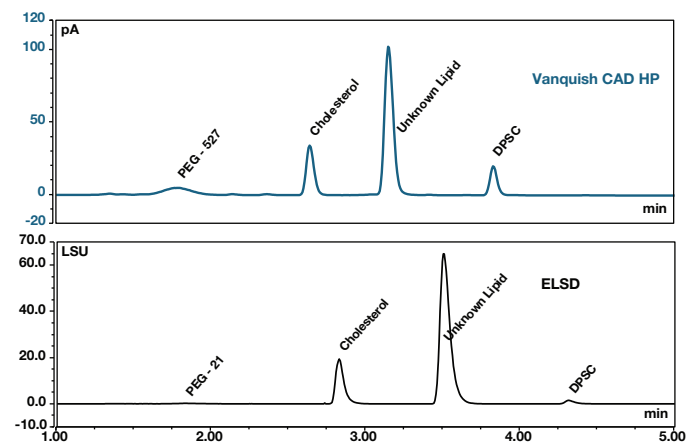
HPLC column	C18 column, 1.7 μ m, 2.1x 100 mm
Mobile phase A	50% 12.5 mM Ammonium acetate, 50% methanol
Mobile phase B	50% Methanol, 50% isopropanol
Column temperature	70 °C
Flow rate	0.7 mL/min
Gradient	See table below
Injection volume	5 μ L
Detectors	CAD and ELSD

Time [min]	B [%]
0	75
1	75
3	85
3.5	85
4	75
5	75

The CAD is more sensitive than ELSD for LNP analysis



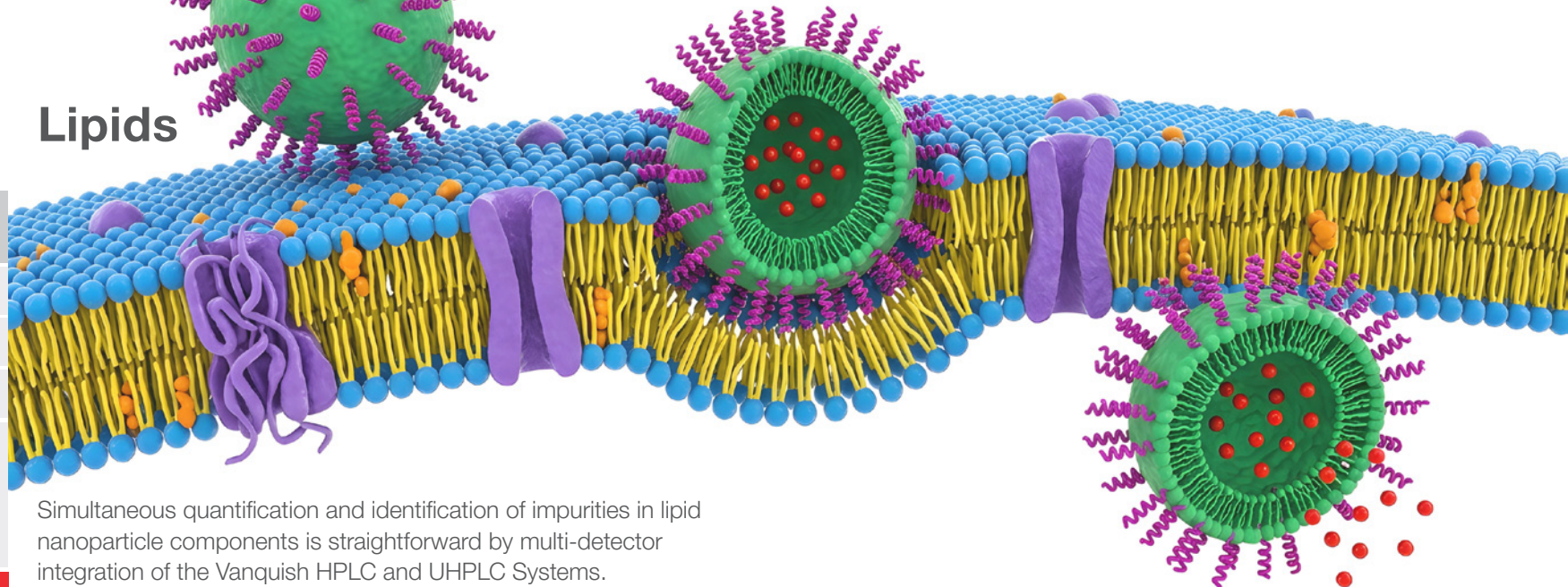
Based on limits of detection (LOD) the CAD was 12 to 47 times more sensitive for the four measured lipids.



Comparison of CAD (top) and ELSD (bottom) for LNP sample testing. Changes in retention times resulted from differences in delay volumes of the two analytical systems.

See white paper: **Why CAD is the preferred universal detector?** - Coming soon

Lipids

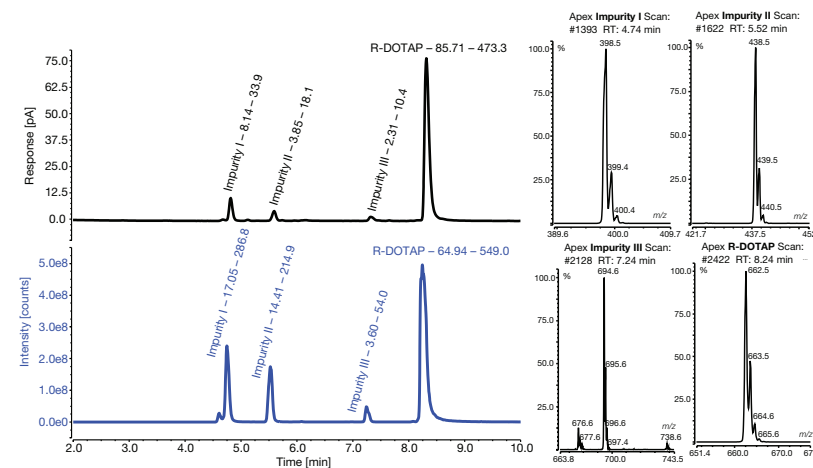


Simultaneous quantification and identification of impurities in lipid nanoparticle components is straightforward by multi-detector integration of the Vanquish HPLC and UHPLC Systems.

In this example, the Thermo Scientific™ Vanquish™ CAD P module was combined with the Thermo Scientific™ ISQ™ EM Single Quadrupole Mass Spectrometer.

HPLC column	Hypersil GOLD C8, 3.0 µm, 3.0 x 100 mm
Mobile phase A	5 mM Ammonium formate in 50% acetonitrile/ 50% water
Mobile phase B	5 mM Ammonium formate in 100% methanol
Column temperature	50 °C
Flow rate	0.7 mL/min
Gradient	See application brief
Injection volume	1 µL
Detectors	CAD and MS

Simultaneous quantification and identification of LNP impurities



Example chromatograms of CAD signal (top) and MS (bottom) and spectra for the impurities found in R-DOTAP

See application brief: [Sensitive cationic lipids impurities analysis with quantitation by charged aerosol detection and simultaneous mass confirmation by MS](#)

See application note: [Quantifying impurities in cationic lipids raw materials with the inverse gradient method using LC-CAD-MS](#)

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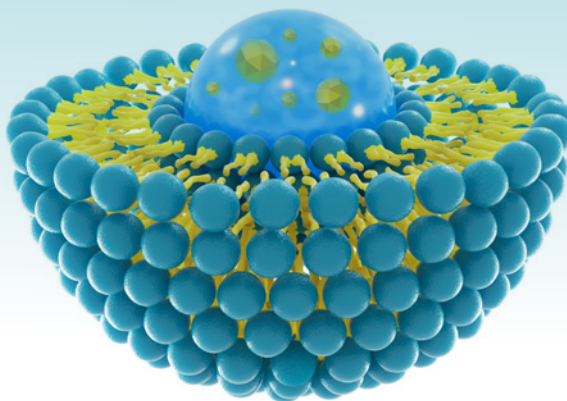
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Thermo Scientific references

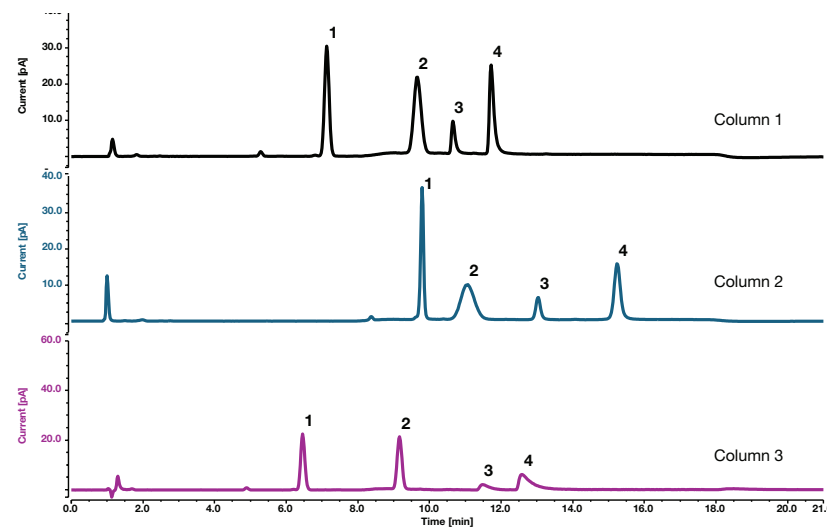
Thermo Scientific columns used

Lipids



Selecting the best column for separation of liposomal lipids

HPLC column	#1 Hypersil GOLD, 3.0 μ m, 3.0 x 150 mm #2 Ethylene-bridged hybrid particle C18, 3.5 μ m, 3.0 x 150 mm #3 Silica particle C18, 3 μ m, 3.0 x 150 mm
Mobile phase A	Acetonitrile/DI water (90/10) (v/v) with 5 mM ammonium acetate
Mobile phase B	100% Methanol with 5 mM ammonium acetate
Column temperature	35 $^{\circ}$ C
Flow rate	0.7 mL/min
Gradient	See technical note
Injection volume	5 μ L
Detector	CAD



Chromatograms for the three columns showing elution of cholesterol (peak 1), 1,2-distearoyl-sn-glycero-3-phosphoethanolamine-N-[methoxy(polyethylene glycol)-2000] - DSPE-PEG2000 (peak 2), and hydrogenated soy phosphatidylcholine - HSPC 1 (peak 3), and HSPC 2 (peak 4)

See technical note: [Best practices for liposome analysis with the charged aerosol detector](#)

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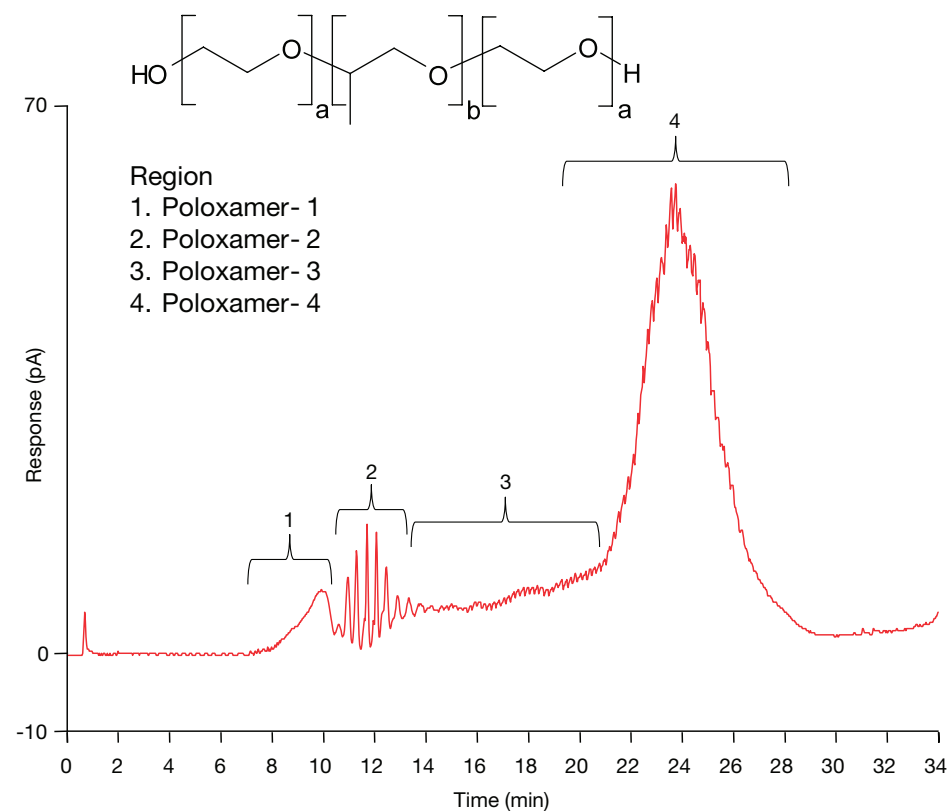
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Thermo Scientific references

Thermo Scientific columns used

HPLC column	Accucore Vanquish C18, 1.5 µm, 2.1 x 150 mm
Mobile phase A	50% Acetonitrile
Mobile phase B	Tetrahydrofuran
Mobile phase C	DI water
Column temperature	50 °C
Flow rate	0.4 mL/min
Gradient	See poster note
Injection volume	2 µL
Detector	CAD

Characterize poloxamer surfactants



Characterization of poloxamer 407.

See poster note: [Characterization and lot-to-lot variability of complex surfactants by high performance liquid chromatography and charged aerosol detection](#)

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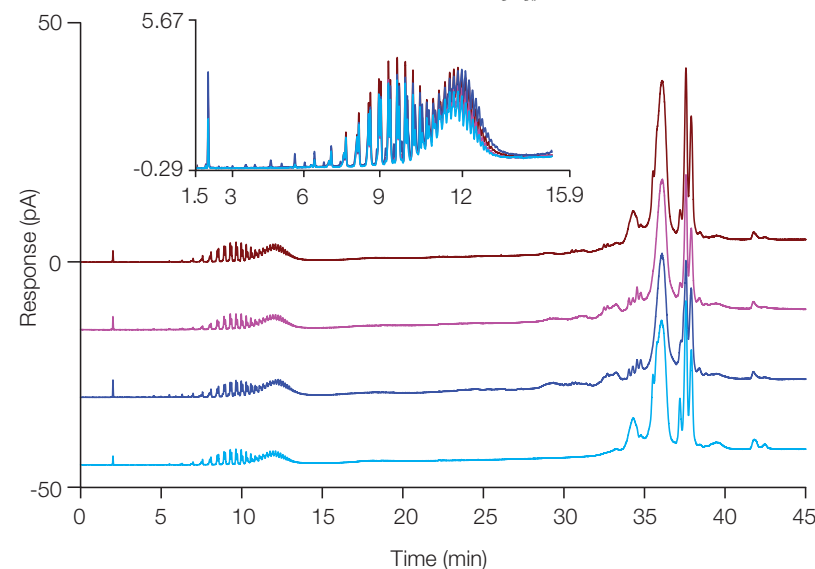
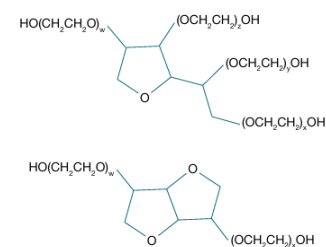


Investigate lot-to-lot variability of polysorbates

HPLC column	Acclaim 300, 3.0 μ m, 4.6 x 150 mm
Mobile phase A	Acetonitrile/methanol/DI water/trifluoroacetic acid (8:2:90:0.1)
Mobile phase B	Acetonitrile/methanol/DI water/trifluoroacetic acid (72:18:10:0.1)
Column temperature	30 °C
Flow rate	0.9 mL/min
Gradient	See first poster note
Injection volume	2 μ L
Detector	CAD

See poster notes: [Evaluation of methods for the characterization and quantification of polysorbates and impurities along with other surfactants and emulsifiers used in the food and pharmaceutical industries](#)

[Characterization and lot-to-lot variability of complex surfactants by high performance liquid chromatography and charged aerosol detection](#)



Determination of lot-to-lot variability. Stacked plot of four commercially available polysorbate 80 products. Low molecular weight components overlaid (inset).

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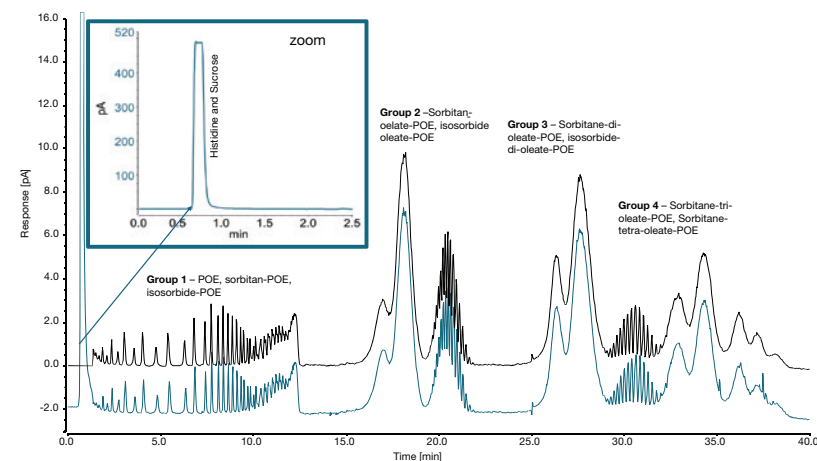
Thermo Scientific references

Thermo Scientific
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Polysorbate 80 (PS80) is a complex mixture comprising hundreds of molecules, arising from the heterogeneous nature of the raw materials used in its synthesis and the synthetic processes involved in producing the final product. This example shows the routine measurement of PS80 components using the diverter valve to eliminate possible interferences from formulation ingredients.

HPLC column	Accucore C18, 2.6 μm , 2.1 x 150 mm
Mobile phase A	5 mM Ammonium formate, pH 4.8
Mobile phase B	50/50 (v/v) Isopropanol/acetonitrile
Column temperature	50 °C
Flow rate	0.4 mL/min
Gradient	See application note
Injection volume	10 μL
Detector	CAD

Use the diverter valve to improve quantification by directing contaminants to waste



The diverter valve can be used to facilitate automated peak area integration by redirecting contaminants to waste. Overlaid chromatograms of a model formulation sample (PS80 + histidine + sucrose). Black trace: Diverter valve to waste (from 0 to 1.3 min); Blue trace: Diverter valve to nebulizer (no switching).

See application note: [Characterization of polysorbate 80 in \(bio\)pharmaceuticals using HPLC-CAD](#)

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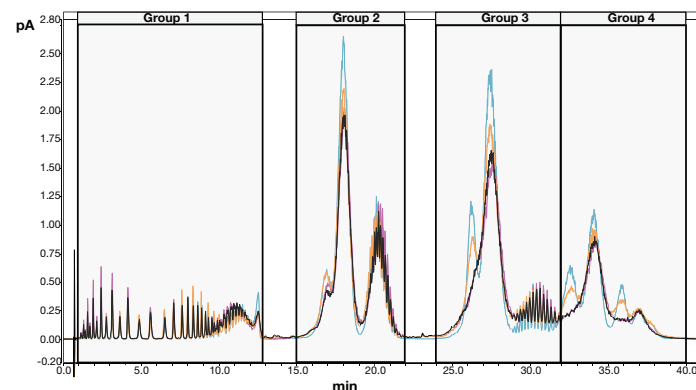
Thermo Scientific columns used

This method can detect batch-to-batch discrepancies and address possible PS80 quality issues in raw materials before their use in drug formulation. Mass detection with the Thermo Scientific™ ISQ™ EM Single Quadrupole Mass Spectrometer ensures identity assignment of the main species.

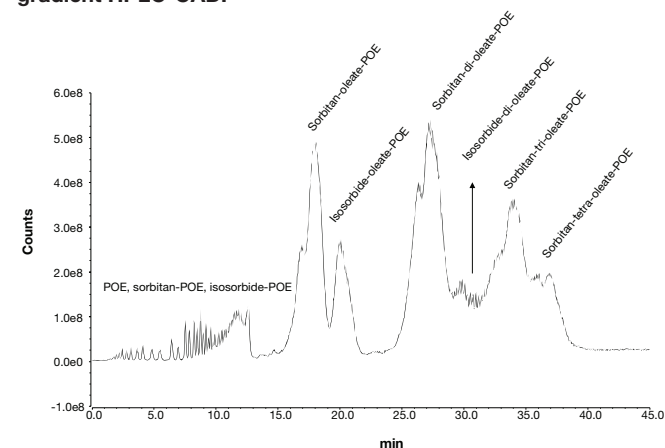
HPLC column	Accucore C18, 2.6 µm, 2.1 x 50 mm
Mobile phase A	5 mM Ammonium formate, pH 4.8
Mobile phase B	50/50 (v/v) Isopropanol/acetonitrile
Column temperature	50 °C
Flow rate	0.4 mL/min
Gradient	See application note
Injection volume	10 µL
Detectors	CAD and Thermo Scientific™ ISQ™ EM Single Quadrupole Mass Spectrometer

See application note: [Polysorbate 80 profiling by HPLC with mass and charged aerosol detection](#)

Using a multidetector platform to both quantify and identify polysorbates



Overlaid chromatogram of four different PS 80 samples determined by gradient HPLC-CAD.



Analysis using the ISQ EM MS. Figure shows the TIC of one of the PS 80 samples.

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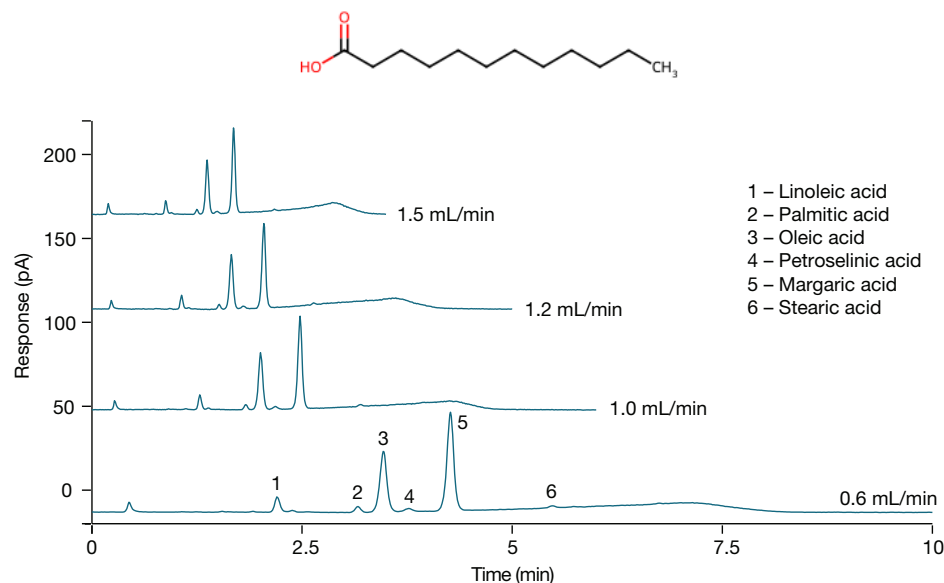
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Thermo Scientific
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Direct measurement of polysorbate impurities

HPLC column	C18, 2.6 µm, 2.1 x 100 mm
Mobile phase A	0.05% Formic acid in DI water
Mobile phase B	0.05% Formic acid in acetonitrile
Column temperature	25 °C
Flow rate	1.5 mL/min
Gradient	See poster note
Injection volume	10 µL
Detector	CAD



We are grateful to Professor Dr. U. Holzgrabe (University of Würzburg) for providing this figure.

Chromatographic separation of different fatty acids found in polysorbate 80 hydrolysates using different flow rates. 1) linoleic acid; 2) palmitic acid; 3) oleic acid; 4) petroselinic acid; 5) margarinic acid; and 6) stearic acid.

See poster note: [Fatty acid analysis in polysorbate 80 by UHPLC-CAD](#)

Refer to article: [Influence of charged aerosol detector instrument setting on the ultra-high-performance liquid chromatography analysis of fatty acids in polysorbate 80](#)

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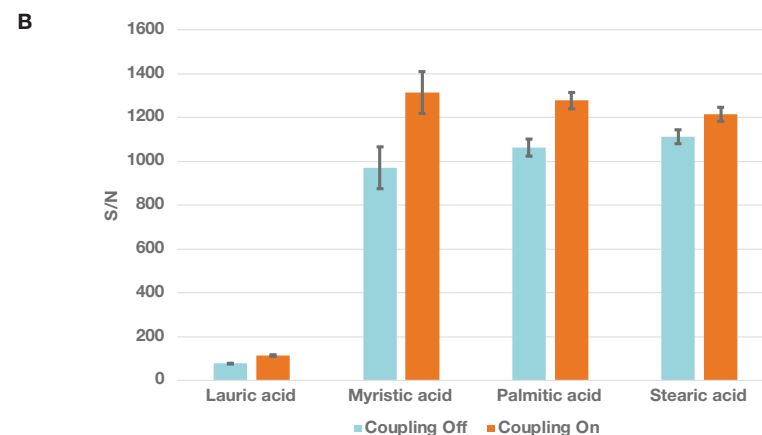
During the manufacturing process, PS can contain impurities such as fatty acids (FAs). During storage or transit, PS in formulations can degrade also forming FAs. These impurities are a major problem as FAs can form insoluble particles that can seriously compromise product quality, efficacy, and patient safety. The **temperature coupling mode** of the Vanquish CAD P Series improves measurement of semi-volatile FA impurities.

HPLC column	Hypersil GOLD C18, 1.9 μ m, 2.1 x 50 mm
Mobile phase A	0.05% Formic acid in DI water
Mobile phase B	0.05% Formic acid in acetonitrile
Column temperature	25 °C
Flow rate	1.5 mL/min
Gradient	See application note
Injection volume	10 μ L
Detector	CAD

See application note: [Characterization of four saturated fatty acids using gradient HPLC-CAD highlighting optimized evaporation temperature control features](#)
See blog: [How to get more accurate HPLC quantitation of semi-volatiles](#)

Boost quantitation of semi-volatile polysorbate impurities

Increase in S/N Coupling On	+46.8%	+35.7%	+20.3%	+9.4%
Volatility	★★★★	★★★☆☆	★★☆☆☆	★☆☆☆☆



A: The % increase in S/N when the temperature coupling mode is turned on correlating with analyte volatility. **B:** The mean S/Ns of the FAs were improved when the temperature coupling mode was turned on (SD calculated for n=6).

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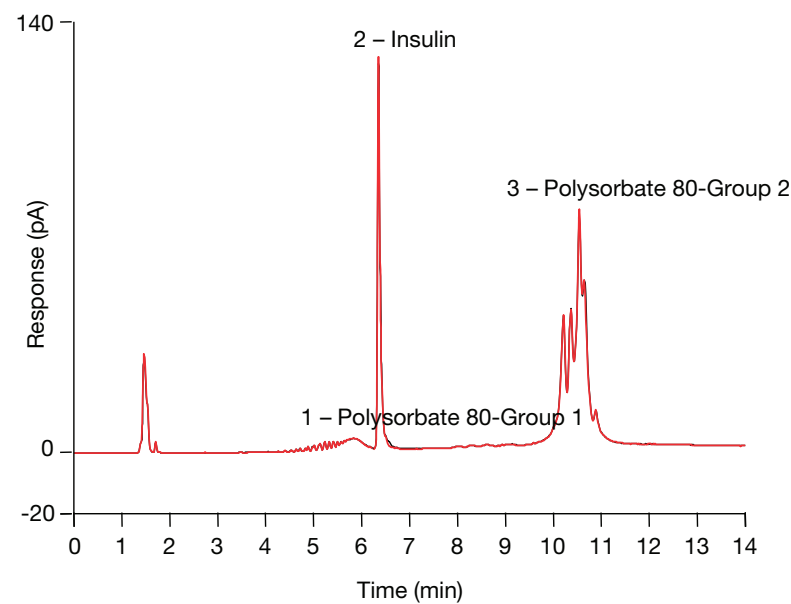
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Thermo Scientific
columns used

HPLC column	Accucore 150-C4, 2.6 μ m, 3.0 x 100 mm
Mobile phase A	0.1% Trifluoroacetic acid
Mobile phase B	0.1 % Trifluoroacetic acid in acetonitrile
Mobile phase C	N-propanol/tetrahydrofuran (80:20)
Column temperature	50 °C
Flow rate	0.5 mL/min
Gradient	See link below
Injection volume	20 μ L
Detector	CAD

Simultaneous measurement of drug and polysorbate in a biopharmaceutical formulation



Simultaneous analysis of insulin and polysorbate 80.

For more information see: [HPLC charged aerosol detector analysis of polysorbate 80 and insulin in a biopharmaceutical formulation](#)

Polyethylene glycol

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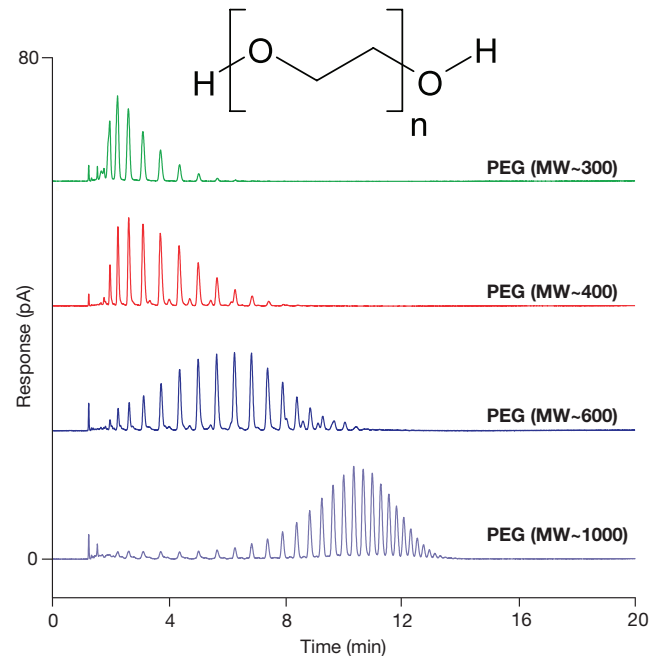
Thermo Scientific references

Thermo Scientific
columns used



HPLC column	Thermo Scientific™ Acclaim™ Surfactant Plus, 3.0 µm, 3.0 x 150 mm
Mobile phase A	100 mM Ammonium acetate, pH 5.0
Mobile phase B	Acetonitrile
Column temperature	30 °C
Flow rate	0.6 mL/min
Gradient	See link below
Injection volume	5 µL
Detectors	CAD

Characterization of different molecular weight PEGs



Characterization of different PEGs.

For more information see: [HPLC charged aerosol detector analysis of polyethylene glycol \(PEG\)](#)

Simultaneous analysis of protein and excipients in biologics using 2D approaches

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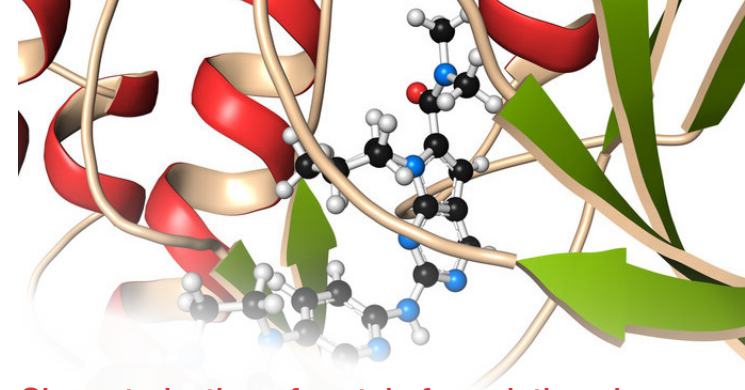
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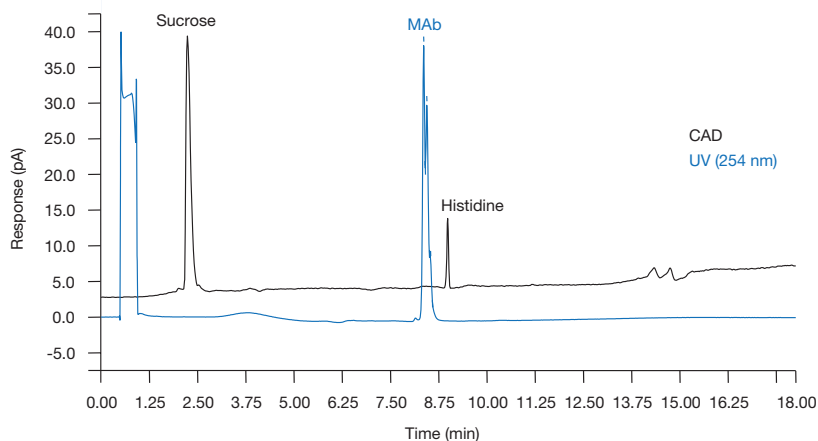
Thermo Scientific references

Thermo Scientific columns used

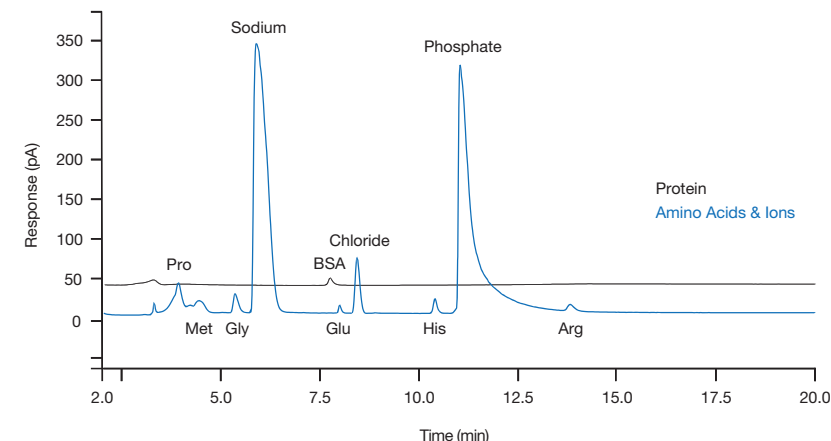


Characterization of protein formulations by 2D-LC with CAD and UV detection

Analysis of a biologic formulation can be extremely challenging. Typically, separate methods are used to measure the biologically active protein and associated excipients. To improve laboratory efficiency with faster analysis times and less sample preparation, these methods can be combined into a 2D heart-cut HPLC approach.



In the example shown below (right figure) the protein was separated in the first dimension using an Accucore 150 C4 Column and measured using a diode array detector. A heart cut (0.5 to 0.8 min) containing the polar amino acids was transferred to a second column via a switching valve. The separation of underivatized amino acid excipients and several ions was achieved using an Acclaim Trinity P1 Column under HILIC conditions and measured using charged aerosol detection.



For other examples using this approach see: [Determination of proteins and carbohydrates by 2D HPLC \(RPLC and HILIC\) with charged aerosol and ultraviolet detection](#)

[Characterization of a biologic therapeutic: Reversed phase analysis of protein and excipients](#)

[Analysis of mock biologic containing protein and amino acid excipients by UHPLC-CAD see: 2D analysis of protein therapeutics and amino acid excipients with combined UV and charged aerosol detection](#)

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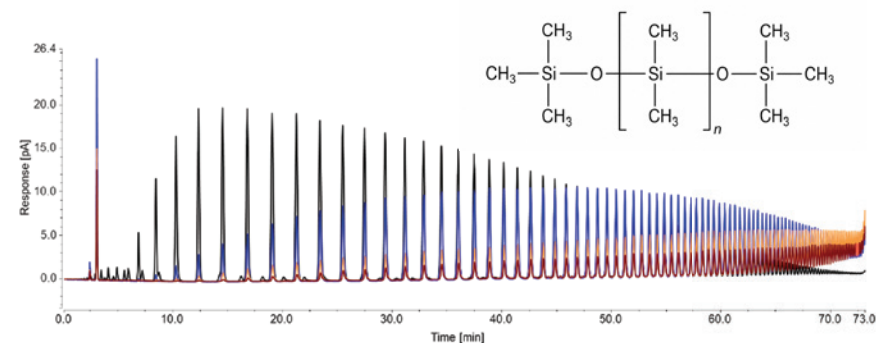
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HPLC column	Acclaim 120 C18, 2.2 µm, 2.1 x 150 mm
Mobile phase A	Methanol
Mobile phase B	Isopropanol
Mobile phase C	Hexane
Column temperature	40 °C
Flow rate	0.4 mL/min
Gradient	See application brief
Injection volume	1 µL
Detector	CAD

Profiling polydimethylsiloxanes in silicone oils using normal phase HPLC and CAD



Overlay of silicone oils with increasing average mass and viscosity.

Black = MW 2000 - 19.7 cST, blue = MW 4000 - 48.0 cST, orange = MW 6000 - 105.4 cST, brown = MW 9000 - 201 cST

See application brief: [Qualitative profiling of polydimethylsiloxane composition in silicone oils using normal-phase HPLC-CAD](#)

See poster note: [Analysis of silicone oils by high performance liquid chromatography and corona charged aerosol detection](#)

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Thermo Scientific™ Vanquish™ CAD P Series

Building on two decades of product expertise, the Thermo Scientific™ Vanquish™ Charged Aerosol Detector P Series delivers high performance for your most complex excipient analysis.

Performance strengths

- Quickly identify the ideal linear response by recording up to four different power values at once
- Temperature coupling mode extends the range of semi-volatile compounds measured
- Seamless method transfers from earlier models by utilizing method translation tool
- More precise and adjustable evaporation tube temperature control
- Fully integrated diverter valve provides more flexibility
 - Increase robustness by preventing detector contamination by removing the CAD from the flow stream
 - Make integration of early eluting analytes more reliable by diverting the matrix to waste
 - Switch between two detectors (e.g., CAD and MS) without replumbing your system

Learn more: [Performance you can see – Vanquish CAD P Series brochure](#)



Utilize the CAD with the wide application flexibility and reliability of the Thermo Scientific™ Vanquish™ HPLC and UHPLC Systems for a worry-free, integrated chromatographic system.



With the external configuration kits, you can add a CAD to any liquid chromatography system from any manufacturer. The Thermo Scientific™ Vanquish™ User Interface (UI) allows you to set and check detector parameters while providing step-by-step maintenance videos and multi-language support. UI features are available independent of external software or PC connection.

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Inverse gradient with the Vanquish CAD P Series

Consistently quantify all non-volatile and semi-volatile compounds during gradient elution even when no reference standard is available.

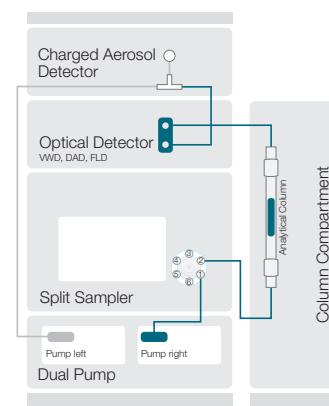
Improve your quantitation without limitation

- CAD response for non-volatiles is independent of chemical structure but does depend upon mobile phase composition
- Changing organic solvent composition over a gradient elution will change the analyte response
- CAD with an inverse gradient approach results in uniform response

Benefits of applying an inverse gradient

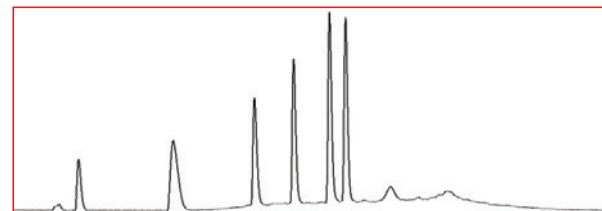
- Simplifies method setup with automatic inverse gradient calculation considering all system volumes when using [Thermo Scientific™ Vanquish™ Inverse Gradient LC Systems](#) with [Thermo Scientific™ Chromeleon™ CDS Software](#)
- Confident uniform response with gradient elution using dual pump technology
- Reliable single-calibrant quantitation of knowns and unknowns

See product spotlight: [Achieving standard-free quantitation](#)
See technical note: [Why use charged aerosol detection with inverse gradient?](#)

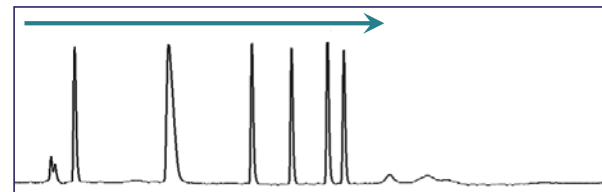


Inverse gradient setup using dual pump technology for single-calibrant quantitation even for gradient separations.

Conventional gradient elution



Inverse gradient compensation



Multi-detection workflow for excipient analysis

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Multi-detection HPLC-UV-CAD-MS platform

Quantify and identify your unknowns with confidence

The seamless combination of complementary LC detectors in a single platform produces a powerful tool for the in-depth characterization of excipients in complex samples.

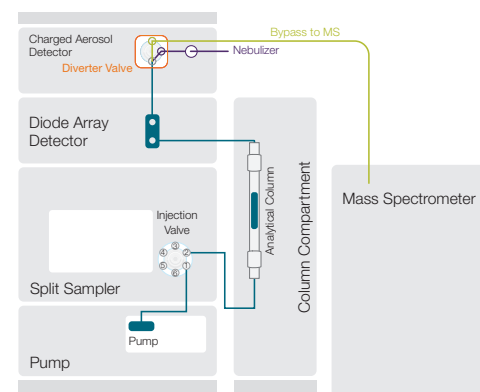
- CAD-UV detection extends the range of compounds measured to include volatile compounds
- CAD-MS detection confirms compound identity or for tentative identification of unknowns

Use an HPLC-CAD-UV-MS setup for detailed sample knowledge

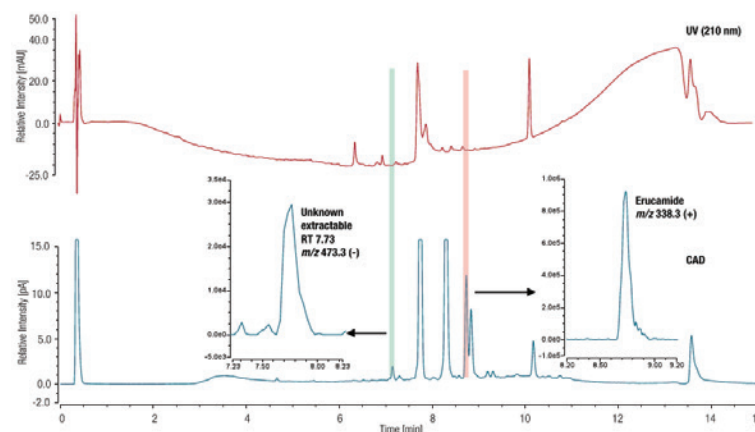
- Quantitation and identification of impurities, degradants, and contaminants
- Thorough analysis of complex drug formulations
- Rapid evaluation of compound purity

See application note: [A reliable UHPLC/UV/CAD/MS multidetector method for routine quantification and library matching of extractables and leachables in pharmaceutical-grade plastics](#)

See application note: [A multi-detector platform comprising UV/Vis, charged aerosol, and single quadrupole mass spectrometric detection for comprehensive sample analysis](#)



With the integrated diverter valve, you can use either the CAD or MS without replumbing. Simultaneous multi-detection setups of two destructive detectors is possible with flow splitting.



Analysis of cell culture bag lining extracts by UV/Vis detector, the CAD, and the MS. UV (210 nm) and CAD chromatograms of Sample C. Several extractables were detected with both detection modes. Insets: XICs of full scans using HESI of two extractables found in several samples. One is an unknown extractable with a retention time of 7.73 minutes and an m/z of 473.3 in negative mode. The other is erucamide.

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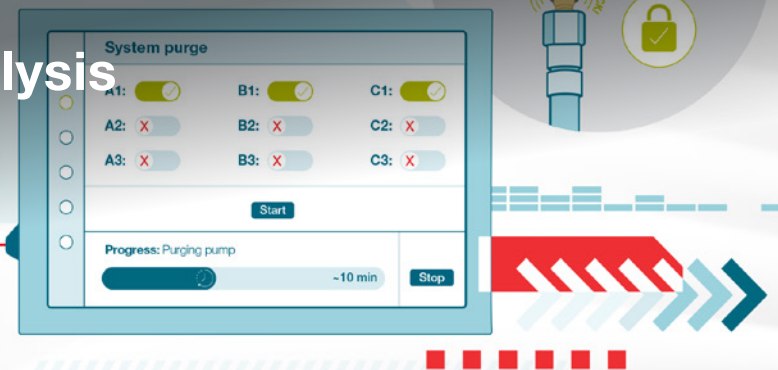
Designed with modular, replaceable components to give you greater flexibility and long-term value, while supporting your sustainability goals. [Built for dependable performance](#) across evolving needs, with intuitive operation and torque-controlled fingertight fittings as standard.

Standard LC systems

Offer a flexible range of pressures, flow rates, column dimensions, and detector options to meet your application and performance needs.

Application-specific LC systems

Leverage advanced configurations—like 2D-LC or Dual LC—and integrated fraction collection to increase productivity, enhance sample knowledge, or optimize your methods.



LC fittings, kits, and accessories

- Confident leak-free connections with torque-controlled [Thermo Scientific™ Viper™ TQ UHPLC Fittings](#)
- Inverse gradient and MS connection kits support a tool-free and stress-free setup



Add-ons for more efficient, reliable, and sustainable workflows

- Prepare and control your analysis directly at the instrument, in a compliant-ready way, with the Thermo Scientific™ Vanquish™ User Interface
- Increased sample capacity for higher throughput with the Thermo Scientific™ Vanquish™ Sample Hub
- Vial bottom detection to help you get more from every sample without damaging your needle
- Wash solvent monitoring that alerts to low volumes and stops sequences if solvent runs dry
- Sustainability improvements that support waste reduction and greener workflows

See brochure: [Vanquish LC systems brochure](#)

Column and vial solutions for excipient analysis

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Column selection is a critical step in excipient analysis, where differences in polarity, ionic character, hydrophobicity, and matrix complexity can influence retention, resolution, and confidence in results. Thermo Fisher Scientific offers a broad portfolio of Thermo Scientific™ HPLC columns to support excipient analysis, impurity profiling, and API-related separations.

- **Thermo Scientific™ Hypersil GOLD™ HPLC Columns** are a strong first choice for method development when high-resolution separations are needed across complex sample matrices.
- **Thermo Scientific™ Accucore™ HPLC Columns** support high efficiency, fast separations, and strong performance with smaller injection volumes.
- **Thermo Scientific™ Acclaim™ HPLC Columns** provide specialized options based on tailored stationary phase designs for applications requiring additional selectivity.

Thermo Scientific vials and caps

For excipient analysis with charged aerosol detection, vial selection matters: leachables may cause baseline artifacts and ghost peaks. [Thermo Scientific™ SureSTART™ Level 3 Vials and Caps](#) help protect valuable samples with ultra-low extractables, supporting sensitivity, selectivity, sample integrity, and reproducible results—choose products marked with three waves.



Column selection guidance

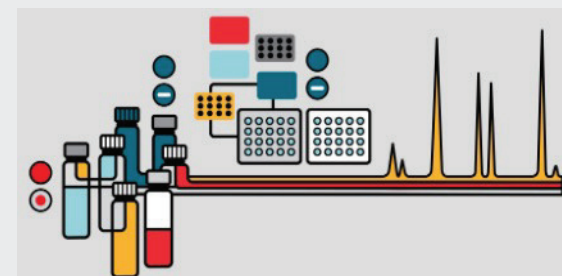
General reversed-phase screening: Begin with [Hypersil GOLD C18 Selectivity](#) or [Accucore C18 Columns](#)

Moderately polar or basic analytes: Move to [Hypersil GOLD aQ](#), [Accucore Polar Premium](#), or other polar-modified phases to increase retention and improve selectivity

Aromatic compounds: Use [Accucore Biphenyl](#), [Accucore Phenyl-Hexyl](#), [Accucore PFP](#), [Hypersil GOLD Phenyl](#), or [Hypersil GOLD PFP Columns](#) to improve aromatic and steric selectivity

Highly hydrophilic compounds: Consider HILIC options such as [Accucore HILIC](#), [Accucore 150-Amide HILIC](#), [Hypersil GOLD PEI HILIC](#), or [Hypersil GOLD Silica Columns](#)

Mixed-mode challenges: For separation of APIs from counter-ions or mixtures with combined ionic and hydrophobic character, [Acclaim Trinity P1](#), [Acclaim Trinity P2](#), [Acclaim WAX-1](#), [Acclaim WCX-1](#), [Acclaim Surfactant](#), and [Acclaim Surfactant Plus Columns](#) provide important specialist options.



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Adjuvant

Any substance that helps promote the effectiveness of a vaccine by reducing the amount or frequency of the required dose, by prolonging the duration of immunological memory, or by modulating the involvement of humoral or cellular responses. This functional definition of adjuvants encompasses a very diverse group of substances whose chemical structures and mechanisms of action vary widely. Adjuvants for human or animal vaccines are typically subjected to rigorous standards of analysis, including quantification of strength, purity, stability, and degradation behavior, even though they are not currently regulated in the same manner as active pharmaceutical ingredients in the US. Complicating such analysis, many adjuvants under investigation contain components that are not readily analyzed by traditional HPLC with UV detection. These include various mixtures of lipids, fatty acids, and glycosides that lack suitable UV chromophores.

Amino acids

Unwanted protein aggregation is a major degradation pathway of protein therapeutics during their storage. Stabilization of protein formulations can be enhanced through the addition of specific amino acids as well as other excipients such as surfactants and sugars. Of all the possible amino acids available, only a selected few are commonly used as excipients in protein therapeutic formulations and include arginine, aspartic acid, glutamic acid, glycine, histidine, lysine, proline, and methionine. They serve as antioxidants, buffers, bulking agents, and stabilizers. For example, glutamic acid and histidine can help adjust the final pH and replace organic buffers such as acetate and citrate, respectively. Methionine can be included as an antioxidant in formulations and arginine has been shown to be highly effective at suppressing aggregation in both liquid and lyophilized formulations, while alanine, glycine, proline, and serine can partially serve in this capacity as well.

Biosurfactants

Biosurfactants are microbial-derived compounds used in drug delivery and pharmaceuticals to improve solubility, stability, and bioavailability of poorly soluble drugs. Examples include glycolipids (e.g., rhamnolipids and sophorolipids) and lipopeptides (e.g., surfactin).

Carbohydrates – cyclodextrins

Cyclodextrins are excipients that can help to solubilize various poorly soluble drugs through the formation of water-soluble drug–cyclodextrin complexes. Cyclodextrins are cyclic oligosaccharides containing six, seven, or eight (α -1,4)-linked D-glucopyranoside units, termed α -, β -, and γ -cyclodextrin, respectively. These parent cyclodextrins can have somewhat limited solubility in water and are often chemically modified to produce cyclodextrin derivatives with greater water solubility. Formation of complexes also improves drug stability and dissolution, leading to a more rapid onset of drug action and a reduction in drug side effects.

Carbohydrates – simple sugars

Simple carbohydrates excipients are used as binders, bulking agents, and sweeteners. In protein therapeutics, like amino acids, they help control unwanted protein aggregation during storage. Typical simple carbohydrates include glucose, lactose, mannitol, mannose, sorbitol, sucrose, and trehalose.

Counterions

The biological and physicochemical properties of an API are greatly affected by its salt form. Selection of a particular counterion can be used to increase or decrease API solubility, alter dissolution rate, improve stability, decrease toxicity, reduce hygroscopicity, improve permeability, and improve drug efficacy.

Lipid nanoparticles (LNPs)

LNPs are used to deliver a wide variety of drugs including antisense oligonucleotides, siRNA therapies, and mRNA vaccines and small molecules. They typically consist of four different lipid species including ionizable lipids, PEGylated lipids, helper lipids, and cholesterol, although the exact composition is usually kept as proprietary information. The CAD is the ideal detector to measure these components as none of them contain a chromophore.

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Liposomes

Liposomes are small, spherical vesicles composed of one or more phospholipid bilayers that can encapsulate aqueous or lipid-soluble substances. They are often used for drug delivery, including cancer therapeutics (e.g., liposomal doxorubicin and liposomal irinotecan) and vaccines.

Poloxamers

Poloxamers are nonionic surfactants used in pharmaceuticals and cosmetics. They are used in pharmaceutical formulations as dispersing agents, emulsifying agents, solubilizing agents, and surfactants. Poloxamers are used in cell culture media as a cellular protectant from the hydrodynamic forces and shear stress during bioprocessing.

Polyethylene glycol

Polyethylene glycol (PEG) is used by the pharmaceutical industry as a solvent, plasticizer, and surfactant, and as a vehicle in dermatological applications, suppositories, parenterals, tablets, and pills. PEG is also attached to biopharmaceutical drugs (PEGylation) to slow down their degradation, increase their duration of action, and to reduce immunogenicity. Macrogol is the international nonproprietary name for PEG when it is used in medicine.

Polysorbates

Polysorbates are non-ionic surfactants and emulsifiers and are used in large quantities throughout the pharmaceutical, food, and cosmetic industries. In biopharmaceuticals, polysorbates prevent surface adsorption and stabilize proteins against stress-induced aggregation, such as agitation and shear. Due to the significant demand across industries, polysorbates are often produced in large lots with the presence of varying limits of impurities (e.g., peroxides, carbonyls, and metals). The characterization and quantification of polysorbates is difficult because these compounds are heterogeneous mixtures with no chromophore. As a result, physical tests and testing for impurities are typically used for release criteria. While this testing is sufficient for the manufacturers to release quality material, it may not be sufficient for the end user. Because polysorbates are used in final formulations, determination of lot-to-lot variability is critical to both the pharmaceutical and biopharmaceutical industries.

Silicone oils

Silicone oils, particularly polydimethylsiloxanes, are important to the pharmaceutical and biopharmaceutical industries, providing essential functionality across drug manufacturing, formulation, and delivery while remaining chemically inert and biocompatible. They are widely used to lubricate prefilled syringes and other delivery systems, ensuring smooth and reliable dosing, and to act as anti-foaming agents in bioprocessing, where they help maintain stable cell culture and fermentation conditions. Silicone oils also serve as surface treatments that minimize protein adsorption and product loss, which is especially critical for sensitive biologic drugs. Their stability across a wide range of temperatures and conditions makes them highly reliable in complex production environments. Despite some challenges, such as potential particle formation, their overall contribution to process efficiency, product quality, and device performance makes them indispensable in modern pharma and biopharma operations.

Surfactants

Surfactants (surface active agents) are a diverse group of chemicals whose structures vary widely but typically contain an oil-soluble hydrophilic chain and a water-soluble hydrophilic group. Surfactants can be categorized based upon their structure and include both ionic (anionic, cationic, and zwitterionic) and nonionic classes. Surfactants play a number of roles including: modulating solubility of APIs, influencing bioavailability of APIs, improving the stability of active ingredients in the dosage forms, modulating immunogenic responses of active ingredients, preventing aggregation or dissociation, helping APIs to maintain preferred polymorphic forms, maintaining the pH and/or osmolality of liquid formulations, maintaining viscosity, acting as antioxidants, emulsifying agents, aerosol propellants, tablet binders, and disintegrants. Surfactants are also used to create emulsions including creams, ointments, liniments, pastes, films, and liquids.

Triton X-100

Thermo Scientific™ Triton™ X-100 (octoxynol-10) is a nonionic surfactant and detergent used to solubilize proteins and help form emulsions. It is also used as a vaccine excipient.

Learn more: [Role of excipients in drug formulation: Functions, types, and applications](#)

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Analysis of silicone oils by high performance liquid chromatography and corona charged aerosol detection

Analytical methods to qualify and quantify PEG and PEGylated biopharmaceuticals

API and counterions in Adderall® using multi-mode liquid chromatography with charged aerosol detection

A platform method for pharmaceutical counterion analysis by HPLC

Application of charged aerosol HPLC detection in biopharmaceutical analysis

Best practices for liposome analysis with the charged aerosol detector

Characterization and lot-to-lot variability of complex surfactants by high performance liquid chromatography and charged aerosol detection

Characterization of four saturated fatty acids using gradient HPLC-CAD highlighting optimized evaporation temperature control features

Characterization of lipid nanoparticle (LNP) composition using UHPLC-CAD

Characterization of polysorbate 80 in (bio)pharmaceuticals using HPLC-CAD

Charged aerosol detection - factors affecting uniform analyte response

Charged aerosol detection and evaporative light scattering detection – fundamental differences affecting analytical performance

Charged aerosol detection – use of the power function and robust calibration practices to achieve the best quantitative results

Determination of proteins and carbohydrates by 2D HPLC (RPLC and HILIC) with charged aerosol and ultraviolet detection

Direct analysis of multicomponent adjuvants by HPLC with charged aerosol detection

Direct analysis of surfactants using HPLC with charged aerosol detection

Effect of mobile phase quality on analytical performance of corona charged aerosol detectors

Enhancement of linearity and response in charged aerosol detection

Evaluating LC methods for enhanced charged aerosol detector response: a case study using underivatized amino acids

Evaluation of methods for the characterization and quantification of polysorbates and impurities along with other surfactants and emulsifiers used in the food and pharmaceutical industries

Fatty acid analysis in polysorbate 80 by UHPLC-CAD

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[Improving the quantitation of unknown impurity analysis using dual gradient HPLC with charged aerosol detection](#)

[List of compendial methods: Thermo Scientific Charged Aerosol Detectors](#)

[Monitoring of anions and cations in early stage product formulation](#)

[Monitoring peptide PEGylation by HPLC with charged aerosol detection](#)

[Multi-modal analyte detection of cyclodextrin and ketoprofen inclusion complex using UV and CAD on an integrated UHPLC system](#)

[New approaches for simultaneous API and counterion analysis using charged aerosol detection](#)

[Optimizing and monitoring solvent quality for UV-vis absorption, fluorescence and charged aerosol detectors](#)

[Polysorbate 80 profiling by HPLC with mass and charged aerosol detection](#)

[Quantitation of pluronics by high performance liquid chromatography and corona charged aerosol detection](#)

[Quantitation of surfactants in samples by high performance liquid chromatography and corona charged aerosol detection](#)

[Quantifying impurities in cationic lipids raw materials with the inverse gradient method using LC-CAD-MS](#)

[Quantitation of APIs and impurities in multi-component drugs by ternary gradient reversed phase chromatography with charged aerosol detection](#)

[Quantification of drug metabolites in early-stage drug discovery testing](#)

[Semiquantitative analysis for high-throughput screening of compound libraries](#)

[Sensitive analysis of underivatized amino acids using UHPLC with charged aerosol detection](#)

[Sensitive cationic lipids impurities analysis with quantitation by charged aerosol detection and simultaneous mass confirmation by MS](#)

[Simple separation and detection techniques for the analysis of carbohydrates](#)

[Simultaneous determination of metformin and its chloride counterion using multi-mode liquid chromatography with charged aerosol detection](#)

[Towards standard-free quantitative and qualitative analysis in liquid chromatography](#)

[Using charged aerosol detection as a universal approach to analyze pharmaceutical salts including inorganic and organic counterions](#)

[Validating analytical methods with charged aerosol detection](#)

[Why use charged aerosol detection with inverse gradient?](#)

For a searchable data base of customer CAD publications, please see [HPLC-CAD Publications](#)



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Hypersil GOLD HPLC columns

Hypersil GOLD C8, 3 µm, 3.0 x 100 mm

Hypersil GOLD C18 Selectivity, 3 µm, 150 x 3 mm

Hypersil GOLD C18 Selectivity, 1.9 µm, 50 x 2.1 mm

Hypersil GOLD PFP 1.9 µm, 2.1 x 100mm

Accucore HPLC columns

Accucore 150-C4, 2.6 µm, 3.0 x 100 mm

Accucore C8, 2.6 µm, 4.6 x 150 mm

Accucore C18, 2.6 µm, 150 x 2.1 mm

Accucore C30, 2.6 µm, 3 x 100mm

Accucore Vanquish C18, 1.5 µm, 2.1 x 150 mm

Acclaim HPLC columns

Acclaim 300 C18, 3 µm, 4.6 x 150 mm

Acclaim Polar Advantage II, 2.2 µm 2.1 x 250 mm

Acclaim Surfactant Plus, 3 µm, 3.0 x 150 mm

Acclaim Trinity P1, 3µm, 3 x 50 mm

Acclaim Trinity P2, 3 µm, 3 x 50 mm

Other

Thermo Scientific MAbPac Reversed Phase, 4 µm, 2.1 x 50 mm

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