

thermo scientific



SOLA Solid Phase Extraction (SPE) cartridges and plates

Join the revolution
Unparalleled performance

ThermoFisher
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Join the revolution: next-generation Solid Phase Extraction (SPE)

Thermo Scientific™ SOLA™ products revolutionize Solid Phase Extraction (SPE). This first fritless SPE product range provides greater reproducibility with cleaner, more consistent extracts.

SOLA products provide unparalleled performance characteristics compared to conventional SPE, phospholipid removal and protein precipitation products.

This includes:

- higher levels of reproducibility
- higher levels of extract cleanliness
- reduced solvent requirements
- increased sensitivity

The proprietary manufacturing process involved in the production of SOLA cartridges and plates, provides an SPE product which eliminates issues normally associated with conventional loose-packed SPE, by combining the polyethylene frit material and media components into a uniform sorbent bed, removing the need for frits (Figure 1).

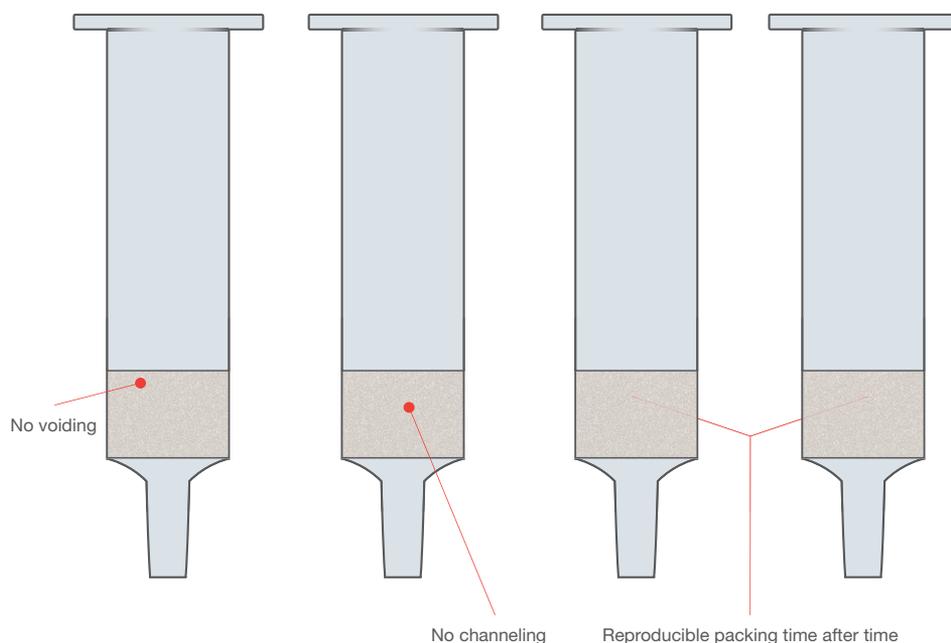


Figure 1: SOLA products eliminate common issues associated with conventional SPE

The manufacturing process has the additional benefit of removing extractables from component parts, resulting in cleaner sample extracts.

SOLA products provide reduced failure rates, higher analysis speeds and lower solvent requirements, which are critical in today's laboratory environment.

The increased performance delivered by SOLA products provides higher confidence in analytical results and lowers cost without compromising ease of use or requiring complex method development.

Conventional SPE cartridges and well plates are packed with a loose powder of silica or polymeric material positioned between two frits. These packed beds are potentially prone to settling and voiding in production or transportation. This creates phase channeling and packing irreproducibility, resulting in reduced recovery and reproducibility in analytical results (Figure 2).

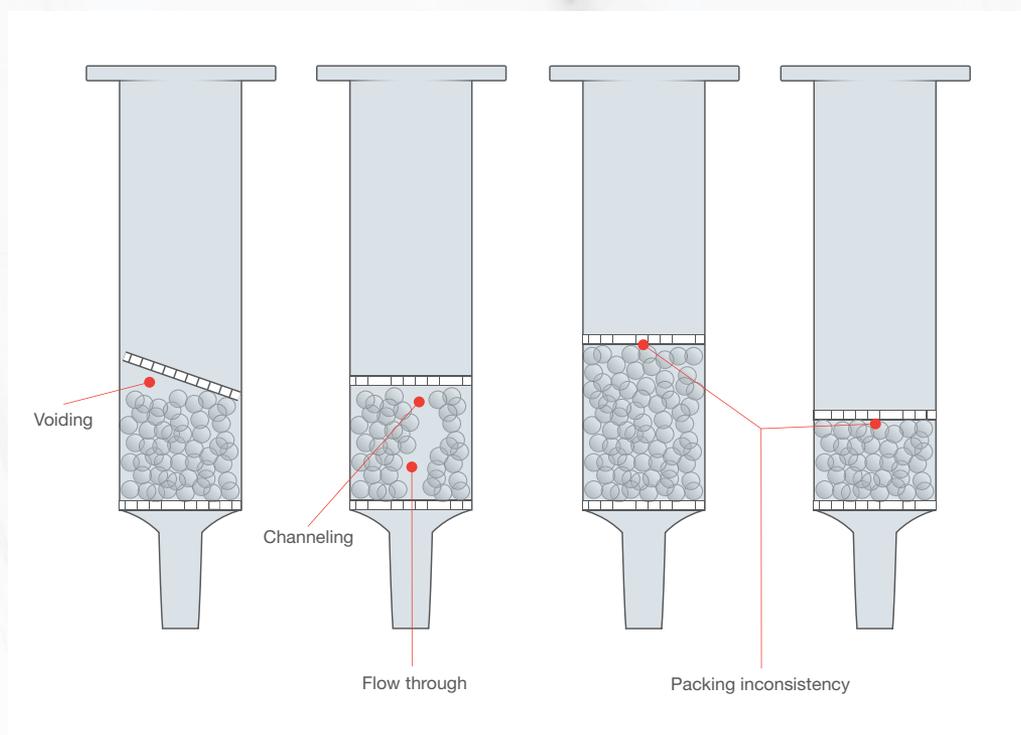


Figure 2: Examples of conventional SPE product issues

Technical information

The following information highlights the advantages associated with SOLA products over conventional loose-packed SPE products.

Improved reproducibility and recovery

Figure 3 shows the reproducibility and recovery levels of SOLA products for three test probes; caffeine, hydrocortisone and carbamazepine when compared to two equivalent loose-packed, low bed weight, competitor products. The data shows that SOLA products outperform competitor products, even when utilizing the recommended generic competitor methodology.

Error bars illustrate significantly lower variability sample-to-sample for SOLA products compared to conventional SPE products, ensuring you achieve the correct result time after time.

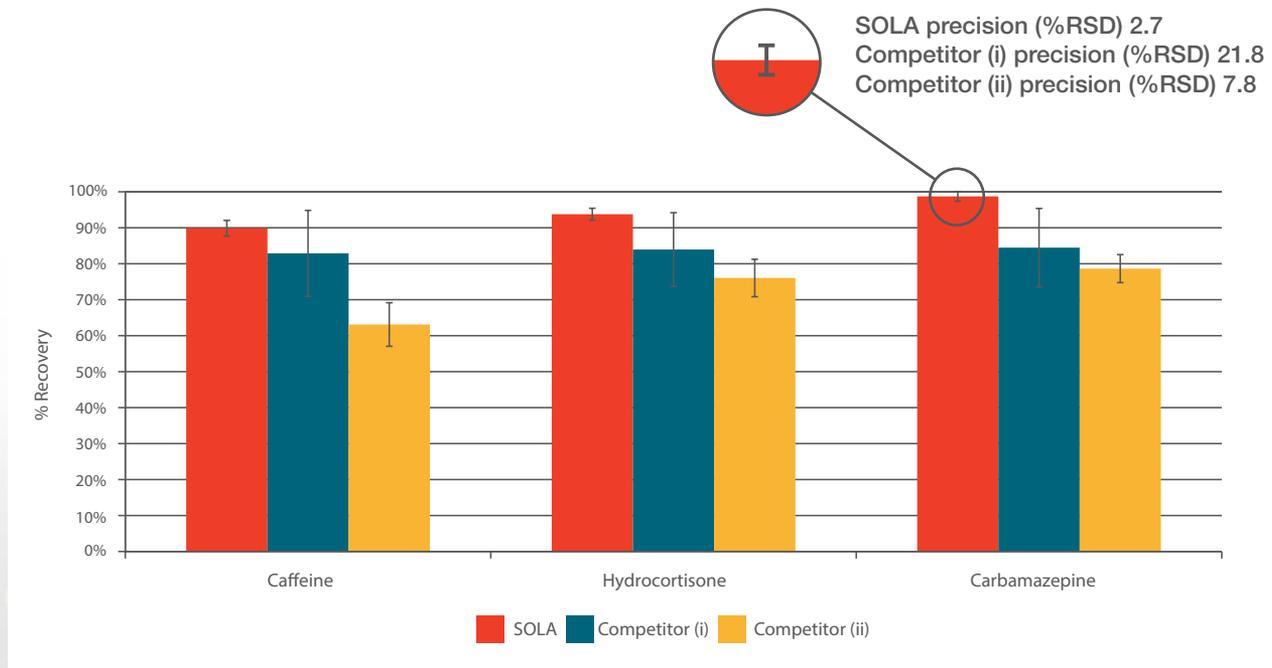


Figure 3: SOLA products shows significantly higher reproducibility and recovery levels

	Caffeine	Hydrocortisone	Carbamazepine
SOLA precision (%RSD)	4.4	3.3	2.7
Competitor (i) precision (%RSD)	23.9	20.5	21.8
Competitor (ii) precision (%RSD)	12.1	10.4	7.8

Method	
Condition	200 µL methanol
Equilibrate	200 µL water
Load	1 mL sample
Wash	200 µL 5% methanol in water
Elute	200 µL methanol

Improved reproducibility

Figure 4 highlights the reproducibility of SOLA products with three test probes; caffeine, hydrocortisone and carbamazepine when compared to an equivalent loose-packed, low bed weight, competitor product. The data shows that SOLA products have consistent recoveries across all thirty test samples. The conventional loose-packed SPE product from competitor (i) shows that on average one in every four samples gives a significantly lower recovery. This results in inconsistencies in results. In comparison, SOLA products provide significantly higher levels of reproducibility, which is vitally important for high-throughput studies.

This improved reproducibility is further demonstrated in Figure 5, which shows that SOLA products have more uniform flow-through characteristics compared to the equivalent loose-packed, low bed weight, competitor products.

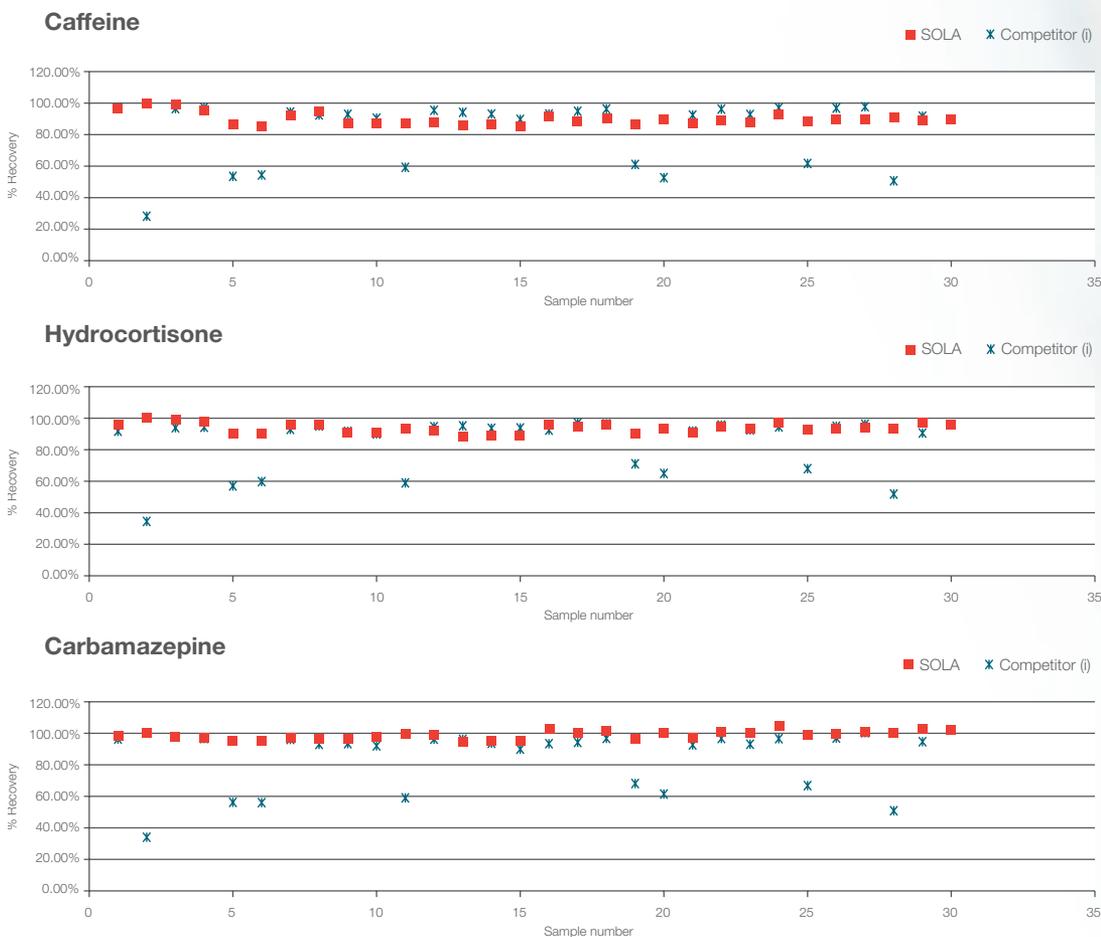


Figure 4: Shows inconsistency of loose-packed products compared to SOLA products

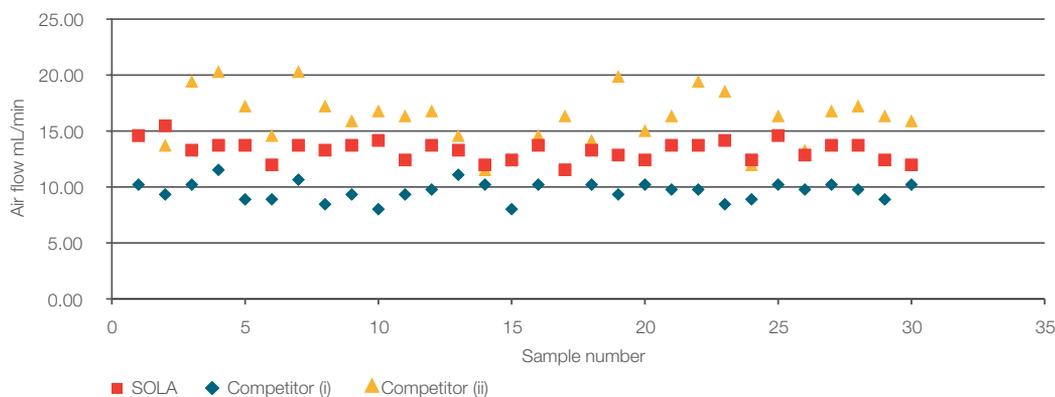


Figure 5: The consistent flow rate of SOLA products compared to equivalent loose-packed products

Reproducibility in plasma

Due to their nature, biological matrices such as plasma present a difficult challenge in obtaining reproducible results. The excellent performance characteristics of SOLA products provide high levels of reproducibility, even when dealing with these difficult matrices. This has been demonstrated by the extraction of rosuvastatin from human plasma using Thermo Scientific™ SOLA™ 96-Well Plate.

Figure 6 shows the precision data for extractions of a fixed concentration of analyte across the entire plate. This can be visually observed in Figure 7, which shows randomly selected overlaid chromatograms of rosuvastatin.

	Precision (%RSD)
Rosuvastatin (area of 96 replicates)	5.4
d6-Rosuvastatin (area of 96 replicates)	3.9
Response ratio (of 96 replicates)	2.7

Figure 6: Precision (%RSD) data for rosuvastatin

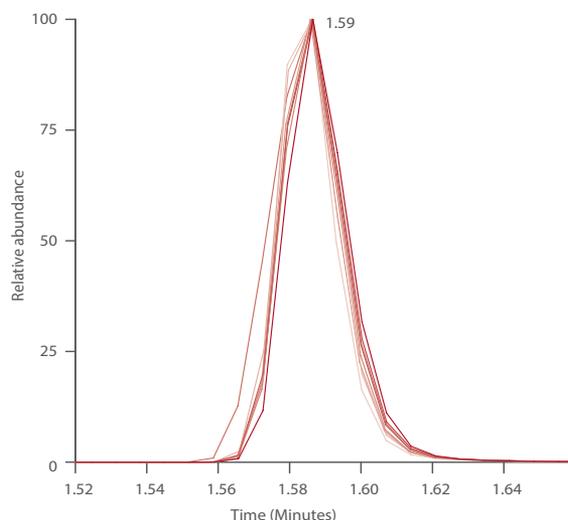


Figure 7: Overlaid chromatograms of rosuvastatin

Higher sensitivity and lower solvent consumption

Figure 8 shows that SOLA products achieve excellent recovery levels even with low volumes of extract solvents, resulting in a more concentrated analyte and increased sensitivity. Additional cost and time saving benefits can be achieved from reduced sample dry-down time and solvent usage.

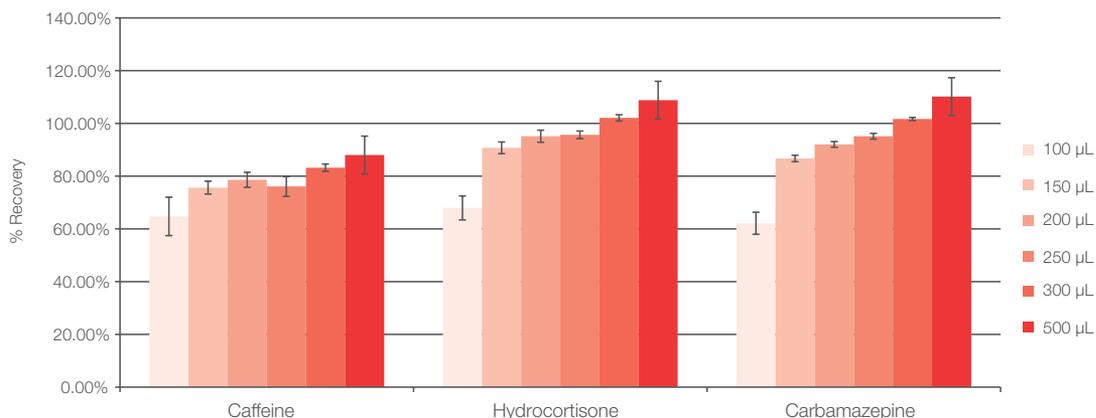
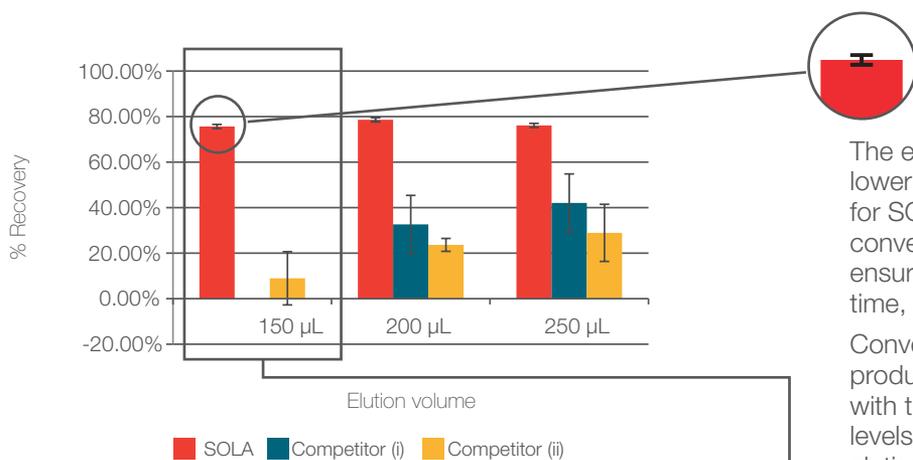


Figure 8: High recovery levels are achieved with SOLA products at low elution volumes, resulting in increased sample concentrations and sensitivity

These low-volume extractions would be significantly compromised when using a conventional loose-packed, low bed weight, SPE product. See Figure 9.

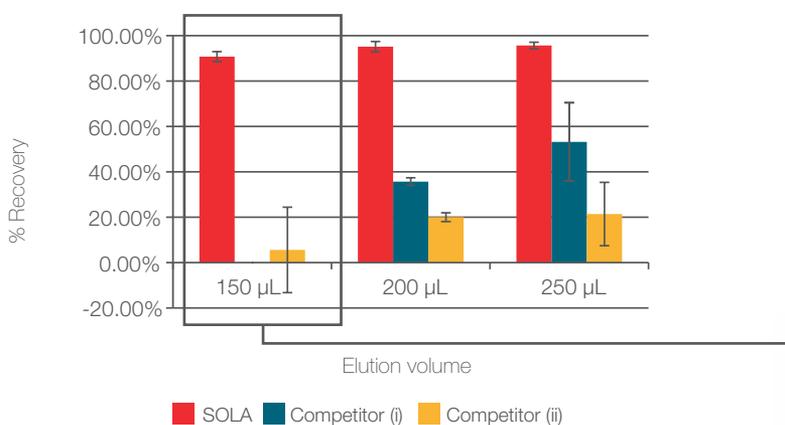
SOLA products exhibit recovery and reproducibility levels at low extraction volumes which are significantly better than conventional loose-packed, low bed weight, competitor products.



The error bars illustrate significantly lower variability sample-to-sample for SOLA products compared to conventional SPE products. This ensures correct results time after time, even at low elution volumes.

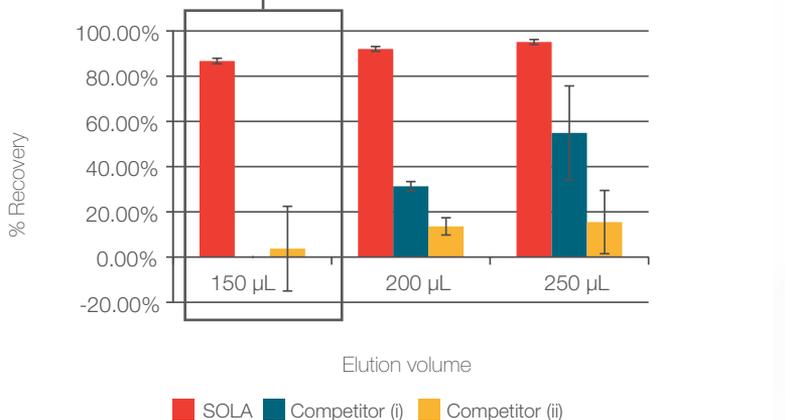
Conventional loose-packed SPE products are unable to compete with the reproducibility or recovery levels of SOLA products at these low elution volumes.

Caffeine



Significantly higher recovery levels are achieved with SOLA products at an elution volume of 150 µL for caffeine, hydrocortisone and carbamazepine compared to competitor loose-packed SPE products.

Hydrocortisone



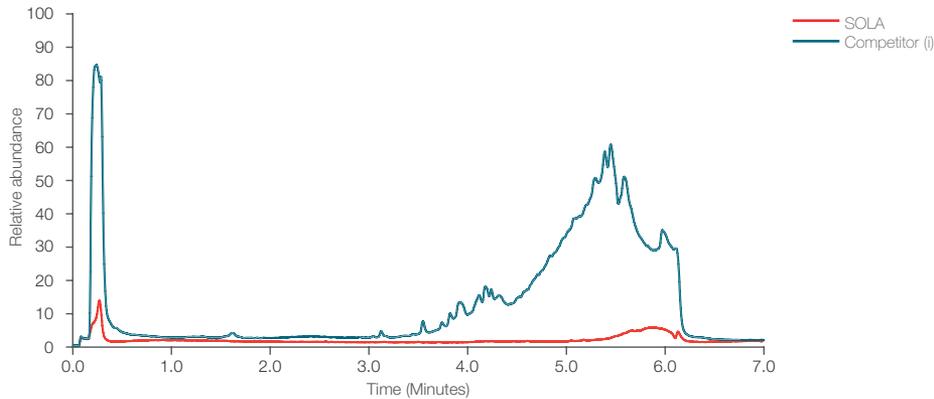
Carbamazepine

Figure 9: SOLA products recovery and reproducibility at lower extraction volumes

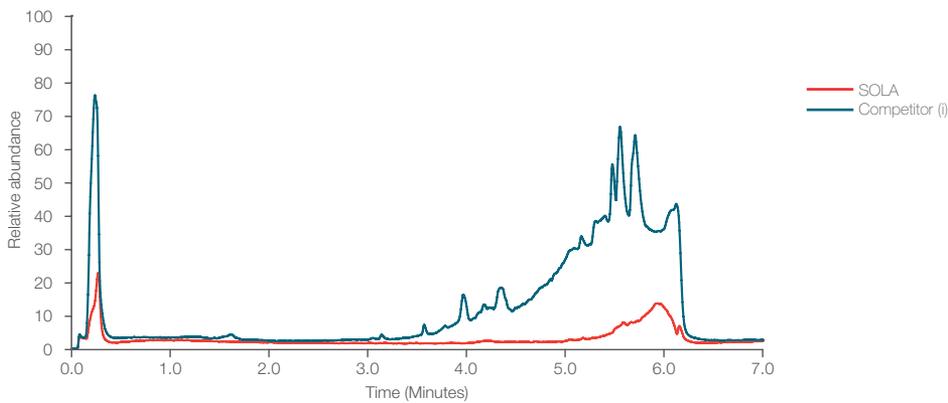


Cleanliness of extract

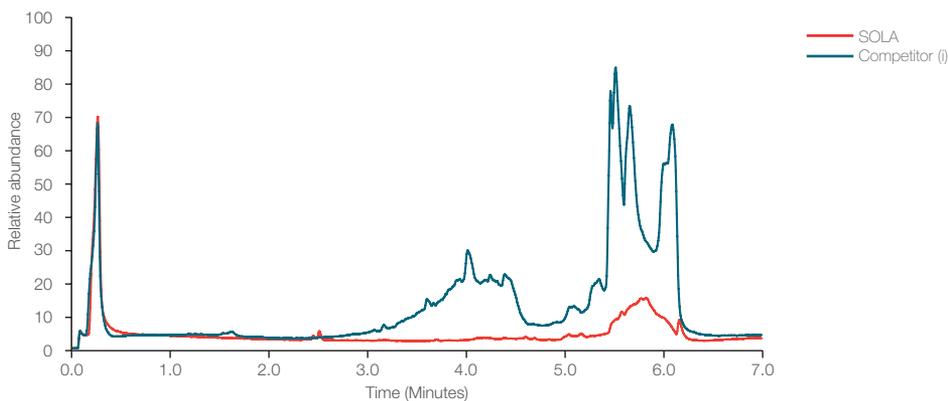
SOLA products proprietary manufacturing process provides a cleaner product and, as a result, a cleaner sample extract. This is shown in Figure 10, where SOLA products are compared against competitor (i) conventional loose-packed SPE product, which have both been extracted with acetonitrile, dichloromethane and methanol, respectively.



Acetonitrile extract comparison: SOLA products versus competitor (i)



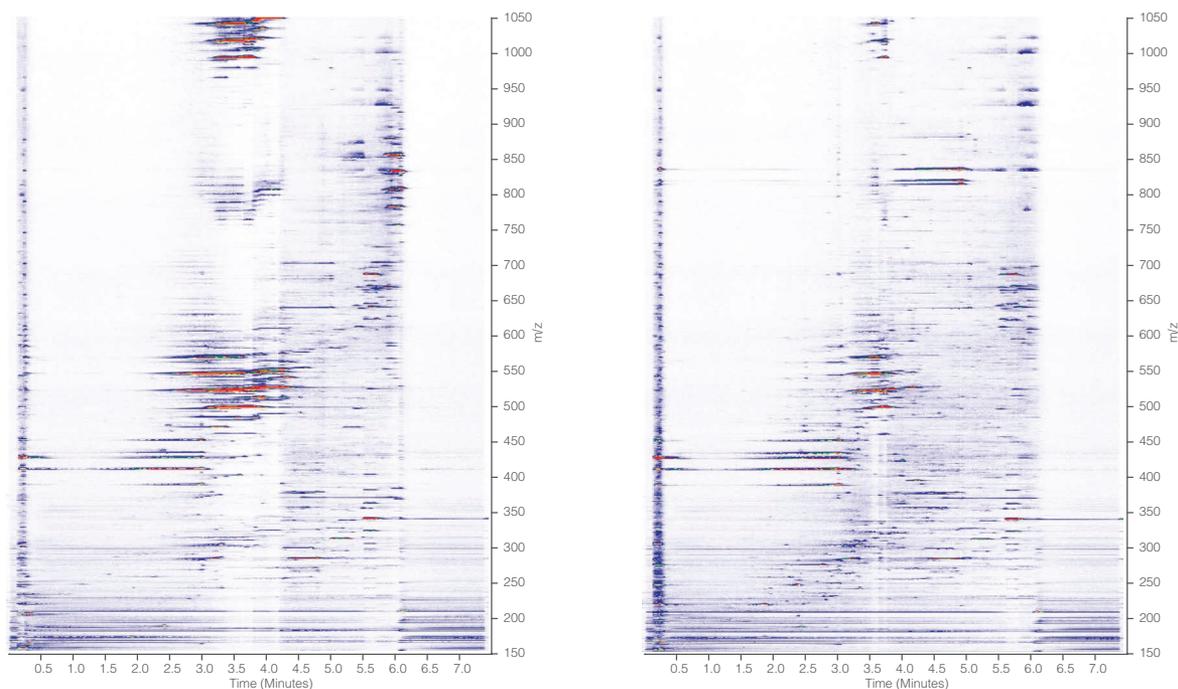
Dichloromethane extract comparison: SOLA products versus competitor (i)



Methanol extract comparison: SOLA products versus competitor (i)

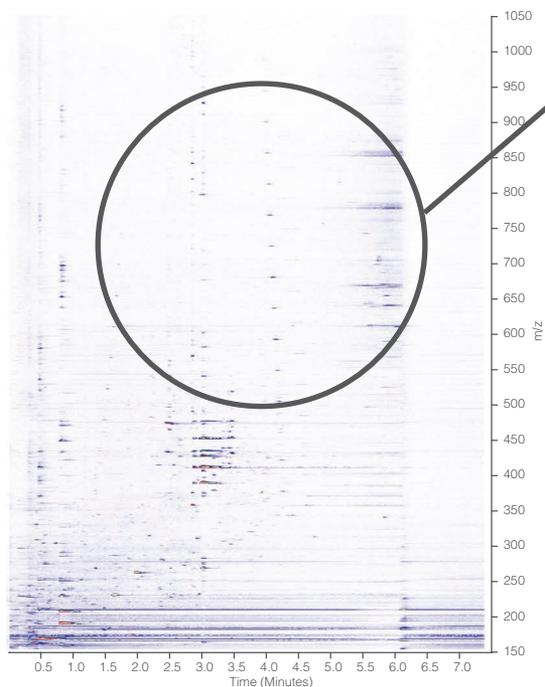
Figure 10: SOLA products are significantly cleaner than the equivalent loose-packed SPE product from competitor (i)

SOLA products offer greater selectivity, reproducibility and cleanliness of sample extract, compared to other sample preparation technologies such as protein precipitation and phospholipid removal plates. This is exemplified in Figure 11, which shows MS contour plots from these respective technologies. It can be seen that SOLA products provide cleaner sample extracts resulting in greater confidence in your analytical results.



Protein precipitation

Phospholipid removal plate

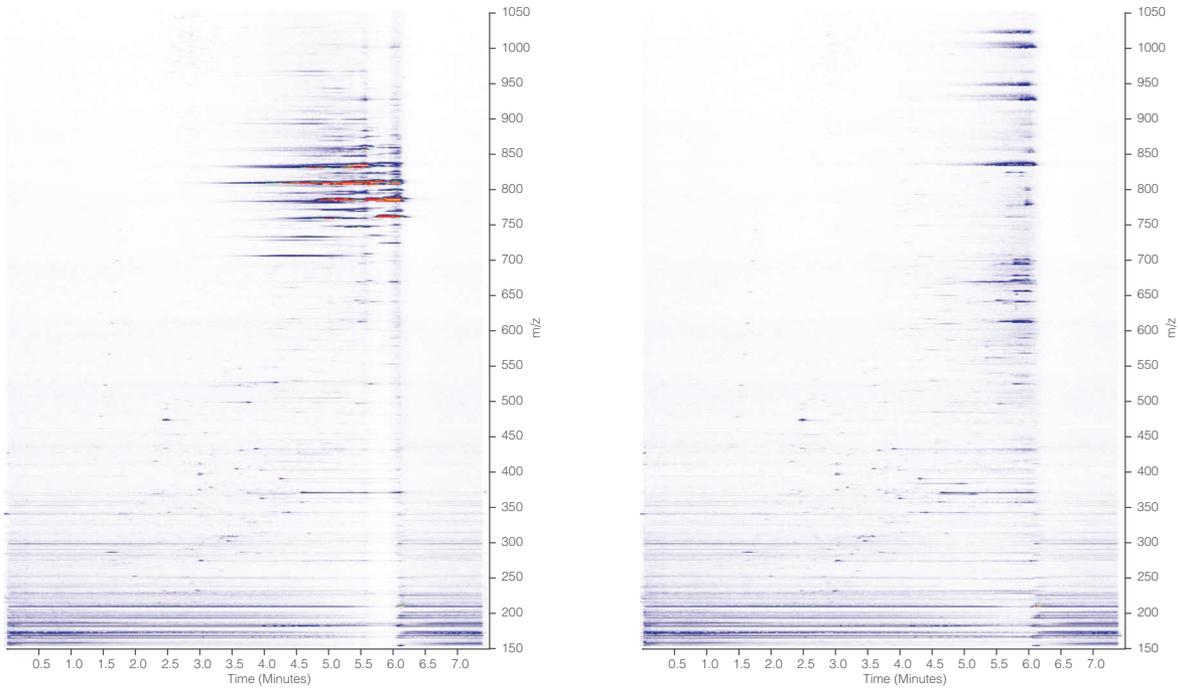


Significantly more interferences have been removed using Thermo Scientific™ SOLA™ SAX Cartridge.

SOLA SAX Cartridge

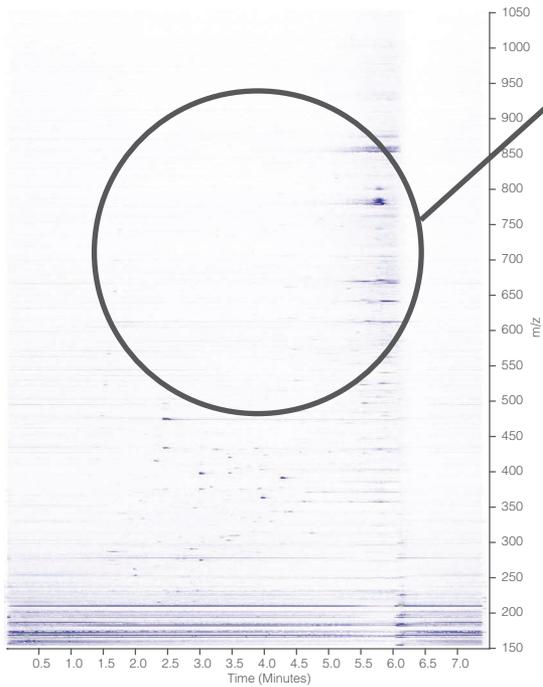
Figure 11: MS contour plots from protein precipitation, phospholipid removal plates and SOLA SAX Cartridge

Failure to remove the matrix interferences in the primary sample preparation process can result in substantial carry over of phospholipids from sample-to-sample. Figure 12 shows MS contour plots of subsequent blank injections. This shows that there is considerable carry over when using protein precipitation or phospholipid removal products when compared to SOLA products. Removal of phospholipids are key to reducing ion suppression, obtaining improved sensitivity in MS detection and providing confidence in analytical results. It also prevents the need for costly column and system maintenance.



Protein precipitation

Phospholipid removal plate



The subsequent blank injection shows a clean MS contour plot with SOLA SAX Cartridge

SOLA SAX Cartridge

Figure 12: MS contour plots of the subsequent blank injections - protein precipitation, phospholipid removal and SOLA SAX Cartridge

SOLA product methods

The previous data shows how SOLA products can outperform conventional loose-packed competitor SPE products, even when using competitor prescribed methodology. The generic SOLA product methods outlined below are designed to be a starting point for most sample extraction protocols.

Generic method protocol for Thermo Scientific cartridge and 96 well plate formats:

SOLA™ HRP cartridge

Reversed-phase

Condition	500 µL methanol
Equilibrate	500 µL water
Load	50 to 500 µL of sample at 1 mL/min
Wash 1	500 µL 5% methanol in water
Elute	200 µL - 500 µL methanol

SOLA™ SCX cartridge

Mixed-mode strong cation exchanger

Condition	500 µL methanol
Equilibrate	500 µL water with 1% formic acid
Load	50 to 500 µL of sample at 1 mL/min containing 1% formic acid
Wash 1	500 µL water with 1% formic acid
Wash 2	500 µL methanol with 1% formic acid
Elute	200 µL - 500 µL methanol with 5% ammonium hydroxide

SOLA™ SAX cartridge

Mixed-mode strong anion exchanger

Condition	500 µL methanol
Equilibrate	500 µL water with 1% ammonium hydroxide
Load	50 to 500 µL of sample at 1 mL/min containing 1% ammonium hydroxide
Wash 1	500 µL water with 1% ammonium hydroxide
Wash 2	500 µL methanol with 5% ammonium hydroxide
Elute	200 µL - 500 µL methanol with 1% formic acid

SOLA™ WAX cartridge

Mixed-mode weak anion exchanger

Condition	500 µL methanol
Equilibrate	500 µL water with 1% formic acid
Load	50 to 500 µL of sample at 1 mL/min containing 1% formic acid
Wash 1	500 µL water with 1% formic acid
Wash 2	500 µL methanol with 1% formic acid
Elute	200 µL - 500 µL methanol with 5% ammonium hydroxide

SOLA™ WCX cartridge

Mixed-mode weak cation exchanger

Condition	500 µL methanol
Equilibrate	500 µL water with 1% ammonium hydroxide
Load	50 to 500 µL of sample at 1mL/min containing 1% ammonium hydroxide
Wash 1	500 µL water with 1% ammonium hydroxide
Wash 2	500 µL methanol with 5% ammonium hydroxide
Elute	200 µL - 500 µL methanol with 1% formic acid

For more advice on how you can use SOLA products to improve your sample preparation, please visit

[thermofisher.com/chromatographyconsumables](https://www.thermofisher.com/chromatographyconsumables)

Beta blockers from urine on SOLA SCX cartridges

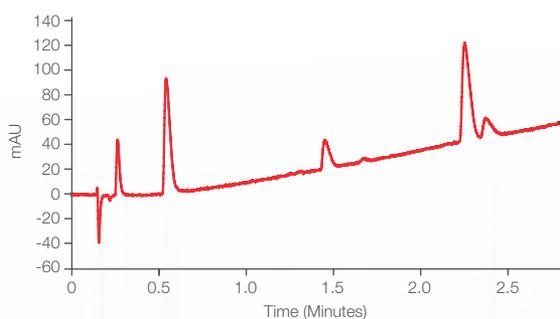
Atenolol, pindolol, metoprolol, propranolol, alprenolol

SOLA SCX SPE protocol

Product	SOLA SCX 10 mg/mL cartridge P/N 60109-002
Matrix	urine
Condition	500 μ L methanol
Equilibrate	500 μ L water
Load	200 μ L spiked urine
Wash 1	250 μ L water + 0.1% formic acid
Wash 2	250 μ L methanol + 0.1% formic acid
Elute	250 μ L 80:20 (v/v) DCM:IPA + 5% ammonium hydroxide
Dry	under nitrogen
Reconstitute	200 μ L 90:10 (v/v) water:methanol

HPLC conditions

Instrumentation	Thermo Scientific™ HPLC
Column	Thermo Scientific™ Accucore™ C18 5 μ m 50 x 2.1mm P/N 17126-052130
Mobile phase A	water + 0.1% formic acid
Mobile phase B	methanol + 0.1% formic acid
Gradient	t/min %A %B
	0.0 90 10
	2.5 60 40
Flow rate	0.7 mL/min
Column temperature	45° C
Injection volume	1 μ L
Detector wavelength	220 nm



Compound	Atenolol	Pindolol	Metoprolol	Propranolol	Alprenolol
Precision (% RSD)	4.2	3.2	3.6	3.8	4.4
% Recovery	88	79	94	88	89

LC-MS/MS method for the determination of enalapril and enalaprilat from human plasma using SOLA HRP well plate

Enalapril, enalaprilat, benazepril (IS)

SOLA HRP SPE protocol

Product	SOLA HRP 96 well plate P/N, 10 mg/2 mL, 60309-001
Matrix	human plasma
Condition	1 mL methanol
Equilibrate	1 mL water
Load	200 µL of spiked human plasma containing internal standard
Wash	200 µL water + 0.1% formic acid
Elute	2 x 200 µL methanol + 2% ammonia
Dry	under nitrogen
Reconstitute	200 µL 90:10 (v/v) water:methanol

Compound	% Recovery	Precision (%RSD)	Accuracy (%difference)
Enalapril	81	6.6	-1.5
Enalaprilat	85	6.6	-7.3

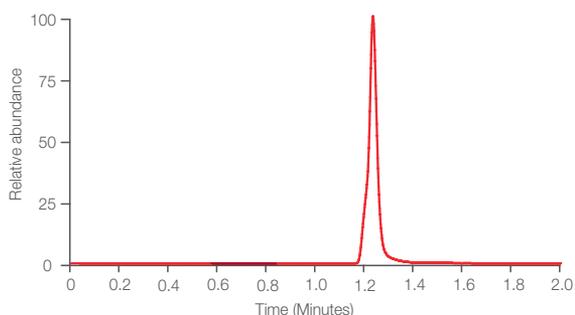
MS conditions

Instrumentation	Thermo Scientific™ TSQ Vantage™
Ionization conditions	HESI
Polarity	positive
Spray voltage	3000 V
Vaporizer temp	317° C
Sheath gas pressure	52 psi
Ion sweep pressure	0 psi
Aux gas pressure	43 psi
Capillary temp	370° C
Declustering voltage	0 V
Collision pressure	1.5
Cycle time (s)	0.02
Q1 (FWHM)	0.7
Q3 (FWHM)	0.7

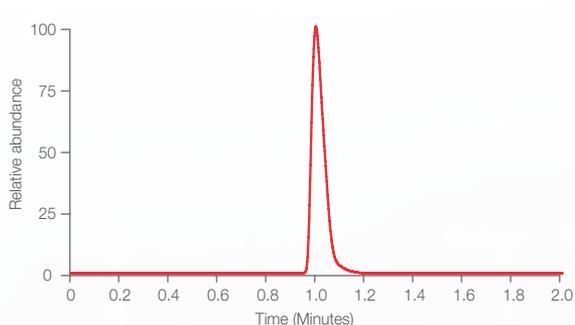
Compound	Enalapril	Enalaprilat	Benazepril (IS)
Parent (m/z)	377.3	349.2	425.3
Products (m/z)	234.2	206.2	351.2
Collision energy (eV)	16	17	19
S-lens	85	80	93

HPLC conditions

Instrumentation	Thermo Scientific™ HPLC	
Column	Thermo Scientific™ Hypersil™ GOLD 1.9 µm, 50 x 2.1mm P/N 25002-052130	
Mobile phase A	water + 0.1% formic acid	
Mobile phase B	acetonitrile + 0.1% formic acid	
Gradient	t/min	%A %B
	0.0	90 10
	1.0	0 100
Flow rate	0.6m L/min	
Column temperature	70° C	
Injection volume	2.5 µL	



Enalapril



Enalaprilat



Separation of bases and neutrals from human plasma and urine using SOLA SCX cartridge

Procainamide, propranolol, amitriptyline, hydrocortisone, corticosterone, progesterone (IS)

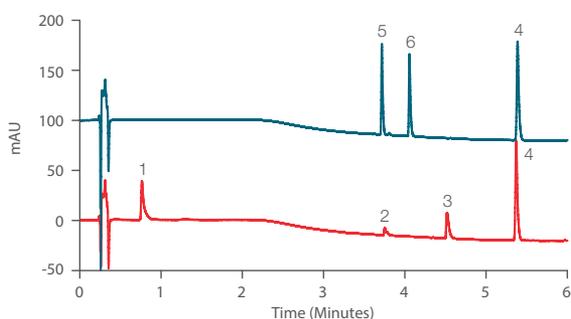
SOLA SCX SPE protocol

Product	SOLA SCX cartridge P/N, 10 mg/mL 60109-002
Matrix	human plasma and urine
Condition	1000 µL methanol
Equilibrate	1000 µL water
Load	350 µL sample
Wash	350 µL water + 2% formic acid
Elute 1	350 µL methanol
Elute 2	350 µL methanol + 5% ammonia dilute or dry and reconstitute as appropriate

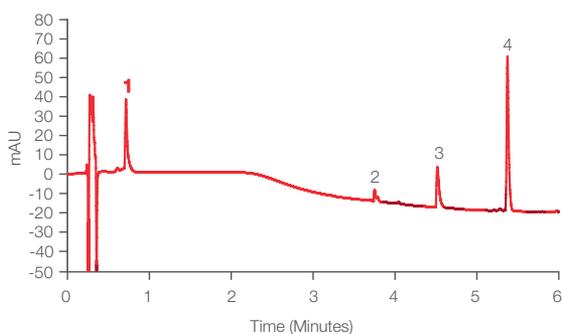
HPLC conditions

Instrumentation	Thermo Scientific HPLC		
Column	Thermo Scientific™ Accucore™ RP-MS 2.6 µm, 50 x 3mm p/n 17626-053030		
Mobile phase A	20mM ammonium acetate		
Mobile phase B	acetonitrile		
Gradient	t/min	%A	%B
	0.0	95	5
	0.5	95	5
	5.0	5	95

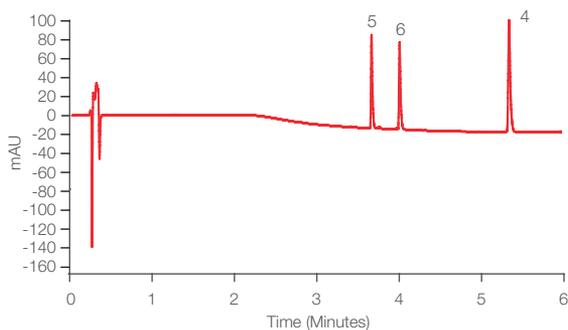
Flow rate	0.8m L/min
Column temperature	25° C
Injection volume	10 µL
Detector wavelength	254 nm



Neutral standard (top trace), Basic standard (bottom trace) showing compounds 2 and 5 co-eluting



Bases extraction



Neutral extraction

Compound	% Recovery	Precision (% RSD)
1. Procainamide	91.6	2.3
2. Propranolol	102.3	3.4
3. Amitriptyline	95.5	2.8
4. Progesterone	Internal Standard	
5. Hydrocortisone	96.7	2.7
6. Corticosterone	95.9	2.9

Pure standard

Compound	% Recovery	Precision (% RSD)
1. Procainamide	87.3	1.7
2. Propranolol	94.2	2.9
3. Amitriptyline	96.9	1.8
4. Progesterone	Internal Standard	
5. Hydrocortisone	98.5	1.3
6. Corticosterone	98.9	1.1

Urine

Compound	% Recovery	Precision (% RSD)
1. Procainamide	98.3	11.8
2. Propranolol	97.6	3.7
3. Amitriptyline	95.3	5.2
4. Progesterone	Internal Standard	
5. Hydrocortisone	91.4	4.6
6. Corticosterone	95.8	6.4

Plasma

LC-MS/MS method for the determination of HCTZ and losartan from human plasma using SOLA SCX cartridge

HCTZ, losartan, furosemide (IS)

SOLA SCX SPE protocol

Product	SOLA SCX cartridge P/N, 10 mg/mL 60109-002
Matrix	human plasma
Condition	1 mL methanol
Equilibrate	1 mL water
Load	100 µL of spiked human plasma containing internal standard
Wash	200 µL water + 0.1% formic acid
Elute	200 µL acetonitrile + 3% ammonia
Dry	under nitrogen
Reconstitute	100 µL 80:20 (v/v) water:acetonitrile

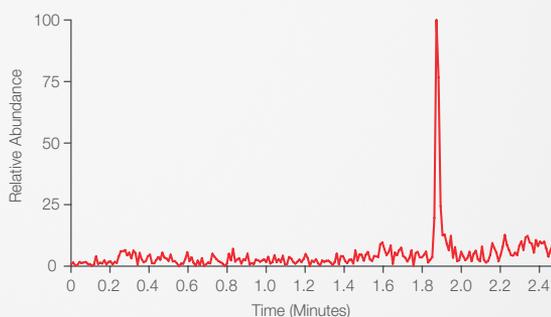
HPLC conditions

Instrumentation	Thermo Scientific HPLC		
Column	Thermo Scientific™ Accucore™ aQ, 2.6 µm, 50 x 2.1 mm P/N 17326-052130		
Mobile phase A	water + 0.1% formic acid		
Mobile phase B	acetonitrile + 0.1% formic acid		
Gradient	t/min	%A	%B
	0.0	80	20
	2.0	30	70
Flow rate	0.4m L/min		
Column temperature	40° C		
Injection volume	2.5 µL		

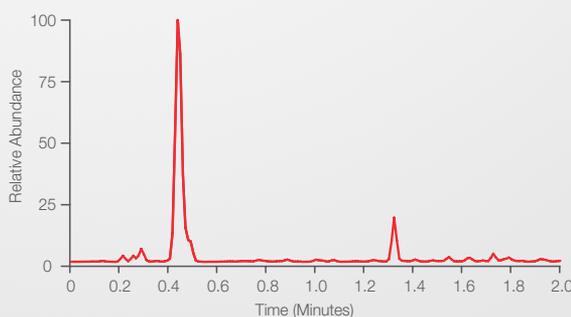
	% Recovery	Precision (% RSD)		Accuracy (% difference)	
		Low QC	High QC	Low QC	High QC
Losartan	65.8	6.1	4.3	11.3	11.6
HCTZ	86.4	3.3	1.6	7.6	0.5

MS conditions

Instrumentation	Thermo Scientific TSQ Vantage
Ionization conditions	HESI
Polarity	+ losartan / - HCTZ and furosemide
Spray voltage	3000 V
Vaporizer temp	300° C
Sheath gas pressure	60 psi
Ion sweep pressure	0 psi
Aux gas pressure	30 psi
Capillary temp	300° C
Declustering voltage	0 V
Collision pressure	1.5
Cycle time (s)	0.5
Q1 (FWHM)	0.7
Q3 (FWHM)	0.7



Losartan



HCTZ

Compound	HCTZ		Losartan		Furosemide (IS)	
Parent (m/z)	295.9		423.2		329.1	
Products (m/z)	205.0	269.0	180.0	207.0	205.0	385.0
Collision energy (eV)	24	20	35	20	22	16
S-lens	98	98	91	91	104	104

UV method for the determination of tricyclic antidepressants from human plasma using SOLA SCX cartridge

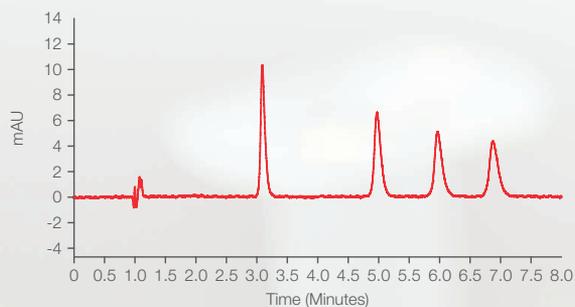
Tricyclic antidepressants

SOLA SCX SPE protocol

Product	SOLA SCX cartridge, 10 mg/mL P/N 60109-002
Matrix	human plasma
Condition	500 μ L methanol
Equilibrate	500 μ L water
Load	450 μ L 1:2 plasma + 100 mM PBS buffer (pH 6.0)
Wash 1	500 μ L water + 0.1% formic acid
Wash 2	500 μ L methanol + 0.1% formic acid
Elute	500 μ L acetonitrile + 5% ammonium hydroxide
Dry	under nitrogen do not apply heat
Reconstitute	150 μ L 80:20 (v/v) water:acetonitrile

HPLC conditions

Instrumentation	Thermo Scientific HPLC
Column	Thermo Scientific Hypersil GOLD 3 μ m, 150 x 2.1mm P/N 25003-152130
Mobile phase	70:30 (v/v) water + 0.1% formic acid /acetonitrile + 0.1% formic acid
Run time	7.5 minutes
Flow rate	0.4mL/min
Column temperature	30° C
Injection volume	1 μ L
Detector wavelength	254 nm



Compound	Doxepin	Imipramine	Amitriptyline	Trimipramine (IS)
Precision (%RSD)	5	4.8	4	5.1
% Recovery	78.9	73.4	74.3	69.7

LC-MS/MS method for the determination of capecitabine from human plasma using SOLA HRP cartridge

Capecitabine

SOLA HRP SPE protocol

Product	SOLA HRP cartridge, 10 mg/mL P/N 60109-001
Matrix	human plasma
Condition	500 μ L methanol
Equilibrate	500 μ L water
Load	200 μ L spiked plasma
Wash	200 μ L 80:20 (v/v) water:methanol
Elute	250 μ L methanol
Dry	under nitrogen
Reconstitute	200 μ L water

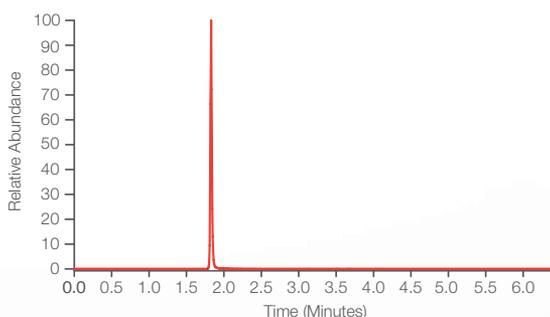
HPLC conditions

Instrumentation	Thermo Scientific HPLC		
Column	Thermo Scientific™ Accucore™ PFP 2.6 μ m, 30 x 2.1mm p/n 17426-032130		
Mobile phase A	water		
Mobile phase B	acetonitrile		
Gradient	t/min	% A	%B
	0.0	100	0
	5.0	0	100
Flow rate	1.0 mL/min		
Column temperature	40° C		
Injection volume	10 μ L		

Compound	Capecitabine
Precision (%RSD)	2.3
% Recovery	73.2

MS conditions

Instrumentation	Thermo Scientific TSQ Vantage
Ionization conditions	HESI
Polarity	Negative
Spray voltage	2500V
Vaporizer temp	350° C
Sheath gas pressure	75 psi
Ion sweep pressure	0.5 psi
Aux gas pressure	45 psi
Capillary temp	300° C
Declustering voltage	0 V
Collision pressure	1.5
Cycle time (s)	0.5
Q1 (FWHM)	0.7
Q3 (FWHM)	0.7



Capecitabine

Compound	Capecitabine	Capecitabine-D8
Parent (m/z)	358.3	366.0
Products (m/z)	154.2	153.7
Collision energy (eV)	21	21
S-lens	94	103

Summary

Compared to conventional SPE loose-packed products, SOLA products deliver:

- significantly increased reproducibility
- more consistent and higher recoveries
- high levels of extract cleanliness
- reduced solvent requirements
- increased sensitivity
- greater sample throughput

In today's demanding laboratory environment, where reproducibility, certainty of results and cost saving are fundamental requirements, SOLA products are an indispensable tool to provide confidence and first-time/every-time success in the analytical process.

Conventional SPE is no longer an option. Join the revolution with SOLA products.

Product information

SOLA products are available in 10 mg/mL cartridge and 10 mg/2 mL 96 well plate formats.

SOLA SPE Cartridges

Description	Bed weight	Column volume (mL)	Cat. no.	Quantity
SOLA HRP	10 mg	1 mL	60109-001	100 pk
SOLA SCX	10 mg	1 mL	60109-002	100 pk
SOLA SAX	10 mg	1 mL	60109-003	100 pk
SOLA WCX	10 mg	1 mL	60109-004	100 pk
SOLA WAX	10 mg	1 mL	60109-005	100 pk

SOLA 96 Well Plates

Description	Bed weight	Column volume (mL)	Cat. no.	Quantity
SOLA HRP	10 mg	1 mL	60309-001	1
SOLA SCX	10 mg	1 mL	60309-002	1
SOLA SAX	10 mg	1 mL	60309-003	1
SOLA WCX	10 mg	1 mL	60309-004	1
SOLA WAX	10 mg	1 mL	60309-005	1

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