GL Sciences

BIOANALYSIS CATALOG

GL Sciences Inc.

FROM SAMPLE PREPARATION TO ANALYTICAL SEPARATION

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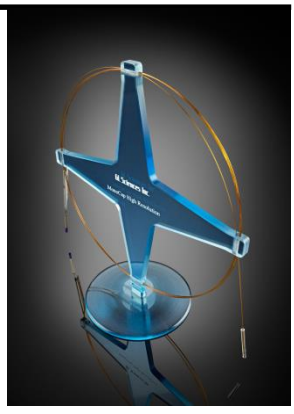


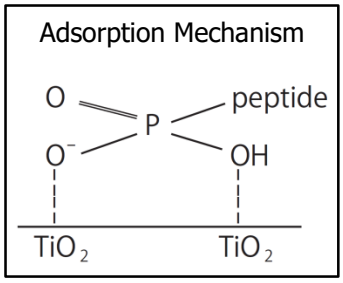
Phosphorylated Protein Research

Protein phosphorylation is recognized as a fundamental process which regulates cell differentiation, growth, and migration. Analyzing protein phosphorylation is complicated by the low concentration of any given phosphoprotein and any one time, and the relatively low ionization efficiency of phosphopeptides in MS analysis. Therefore, enrichment of phosphopeptides and the relative reduction of non-phosphorylated peptides is critical to accurate analysis of protein digests by LC/MS.

GL Sciences' Titanium Dioxide (TiO2 or Titania) products have emerged as the most effect means of phosphopeptide enrichment of protein digests prior to LC/MS analysis, replacing IMAC as the primary means of phosphopeptide sample pretreatment. Enrichment by titanium dioxide and IMAC, remain, however, complimentary techniques and are often used in combination to obtain optimal phosphopeptide analysis.

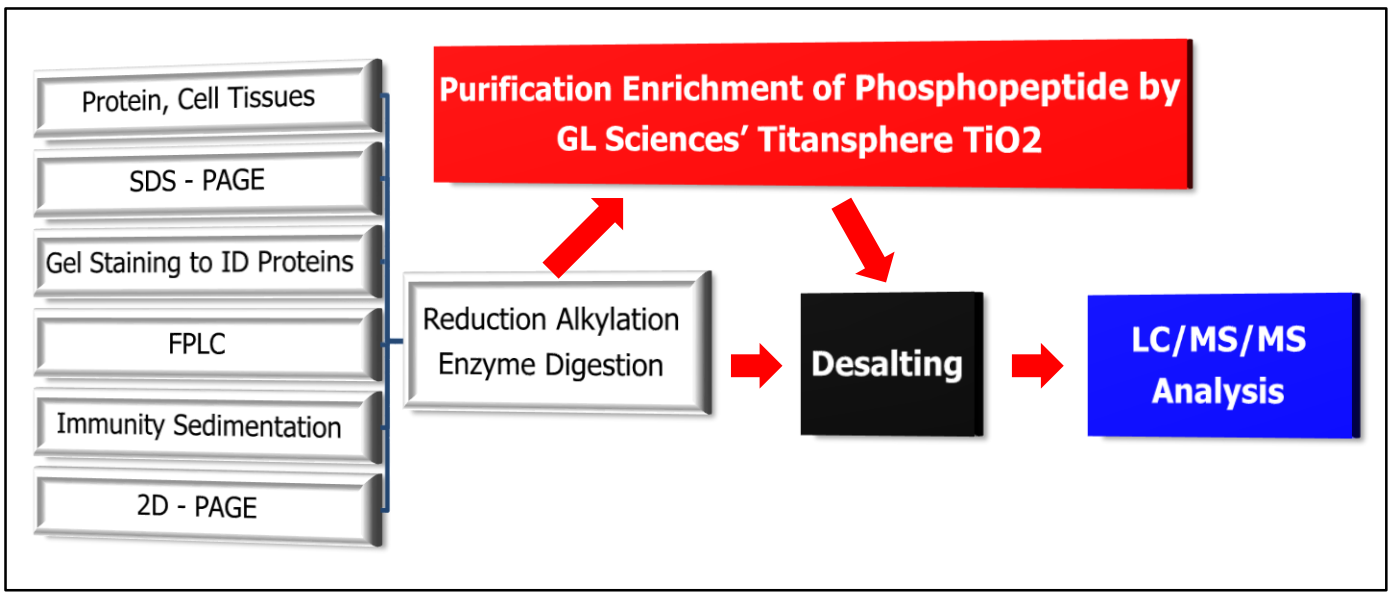
What Makes GL Sciences' Titanium Dioxide Products Unique and Superior?
Titanium Dioxide exists in three crystaline forms, known as rutile, anatase, and brookite. Rutile and Anatase forms are the most common and most useful for phosphopeptide enrichment, and the ratio of rutile form to anatase form has significant implications for applicabililty to enrichment of phosphopeptides. GL Sciences' manufacturing technique for it's phosphopeptide enrichment products produces a highly spherical bead with the optimum ratio of crystal forms of TiO2. The primary reasons the GL Sciences' Pho-TiO products show superior performance is a direct result of the unique formulation of our titanium dioxide beads.

Principal of Phosphopeptide Enrichment



Phosphate groups are preferentially adsorbed to the surface of titanium dioxide under acidic condtions and are eluted under basic condition. Non-phosphorylated acid peptides non-specifically bound to the TiO2 can be reduced by adding acid modifiers to the loading and/or wash buffers.

Basics of Phosphopeptide Analyses by LC/MS/MS



Titansphere™ Bulk Materials

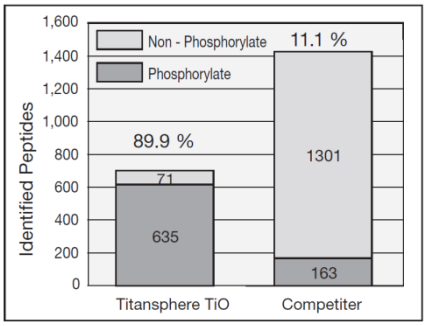
Bulk Sorbent Materials for Purification & Enrichment of Phosphopeptides

While GL Sciences' Phos-TiO spin columns based enrichment products are useful for most sample pretreatment applications, some investigators require bulk titanium dioxide media for specialized applications. Our market leading Titansphere Phos-TiO Kit is now available in bulk media which is Titansphere Phos-TiO 10 µm bulk media, and is optimized for purifying and enriching more phosphopeptide.

Applications

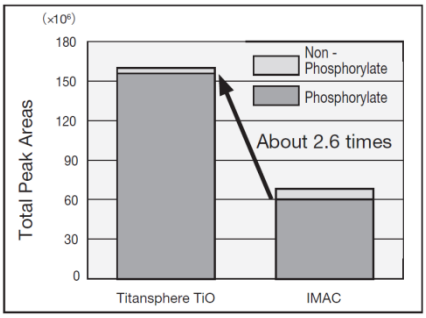
Efficient Purification from HeLa Cell Lysate
The data at right shows the superior performance of Titansphere TiO using the HeLa Cell Lysate consisting mainly of non-phosphorylated peptides. Titansphere TiO shows exceptional selectivity - almost 90% of the bound peptides were phosphopeptides, and excellent capacity for total phosphopeptide binding. A competitive TiO product is shown, binding mainly non-phosphorylated peptides and a much lower total number of discreet phosphopeptide species.

Sample: HeLa Cell Lysate, Sample volume: 50 µg,
Titansphere TiO volume: 1 mg



Compare Titansphere TiO with IMAC
The graph at right shows how Titansphere TiO compares to an IMAC enrichment using Arabidopsis cell extract. Titansphere TiO provides substantially higher total capacity and a much higher number of discreet phosphopeptides isolated.

Sample: Arabidopsis Cell Extract, Sample volume: 100 µg,
Titansphere TiO volume: 1 mg



Specifications

Description	Titansphere TiO
Particle Size	5 µm, 10 µm
Particle Shape	Spherical
Adsorption Spot	Titanium Dioxide Crystal
Pore Size	100 Å (10 µm)
pH Range	2 ~ 12
Gravity	1.74

Ordering Information

Titansphere™ Bulk Materials (Previous Version)

Description	Particle Size	Qty	Cat. No.
Titansphere TiO 5 µm, 500 mg	5 µm	1/pk	5020-75000
Titansphere TiO 10 µm, 500 mg	10 µm	1/pk	5020-75010

Titansphere™ Phos-TiO Bulk Material

Bulk Sorbent Materials for Purification & Enrichment of Phosphopeptides

While GL Sciences' Phos-TiO spin tips based enrichment products are useful for most sample pretreatment applications, some investigators require bulk titanium dioxide media for specialized applications. Our market leading Titansphere Phos-TiO Kit is now available in bulk media which is Titansphere Phos-TiO 10 µm bulk media, and is optimized for purifying and enriching more phosphopeptide.

References

1. Phosphopeptide enrichment by aliphatic hydroxy acid-modified metal oxide chromatography for nano-LC-MS/MS in proteomics applications, Sugiyama N, Masuda T, Shinoda K, Nakamura A, Tomita M, Ishihama Y., Mol Cell Proteomics. 2007 Jun;6(6):1103-9.

2. Highly selective enrichment of phosphorylated peptides using titanium dioxide, Nature Protocols 1, 2006, 1929-1935

3. Global, in vivo, and site-specific phosphorylation dynamics in signaling networks, Olsen JV, Blagoev B, Gnad F, Macek B, Kumar C, Mortensen P, Mann M., Cell. 2006 Nov 3;127(3):635-48.

4. Successive and selective release of phospholylated Peptides captured by Hydroxy Acid-Modified Metal Oxide Chromatography, Yutaka kyono, Naoyuki Sugiyama, Koshi Imami, Masaru Tomita, and Yasushi Ishihama, J Proteome Res., 2008, 7(10), 4585-93

5. Extended coverage of singly and multiply phosphorylated peptides from a single Titanium Dioxide Microcolumn, Anal Chem., 2015, 87(20), 10213-21

Ordering Information

Titansphere™ Phos-TiO Bulk Material (Same Bulk Media packed into Titansphere Phos-TiO Kit)

Description	Particle Size	Qty	Cat. No.
Titansphere Phos-TiO Bulk 10um, 500 mg	10 µm	1/pk	5010-21315

NEW Titansphere™ Phos-TiO MP Kit

Efficiently Enrich BOTH Singly and Multiply Phosphorylated Peptides

GL Sciences' is known as the best manufacturer for the enrichment/purification of phosphopeptide, which our Titansphere Phos-TiO kit and bulk resins are widely used throughout the world in major cancer research institutes and proteomics core facilities.
The new Titansphere Phos-TiO MP Kit employs a new protocol in the HAMMOC method, which enables highly efficient and selective recovery of not only singly, but also for multiply phosphorylated peptides. Specifically, the new kit fractions the singly and multiply phosphorylated peptides separately, which prevents ion suppression in LC-MS/MS detection and delivers higher recovery of multiply phosphorylated peptides.

Features

- High Recovery of not only Singly, but also for Multiply Phosphorylated Peptides.
- All Operation is done using an Easy-To-Use Centrifuge.

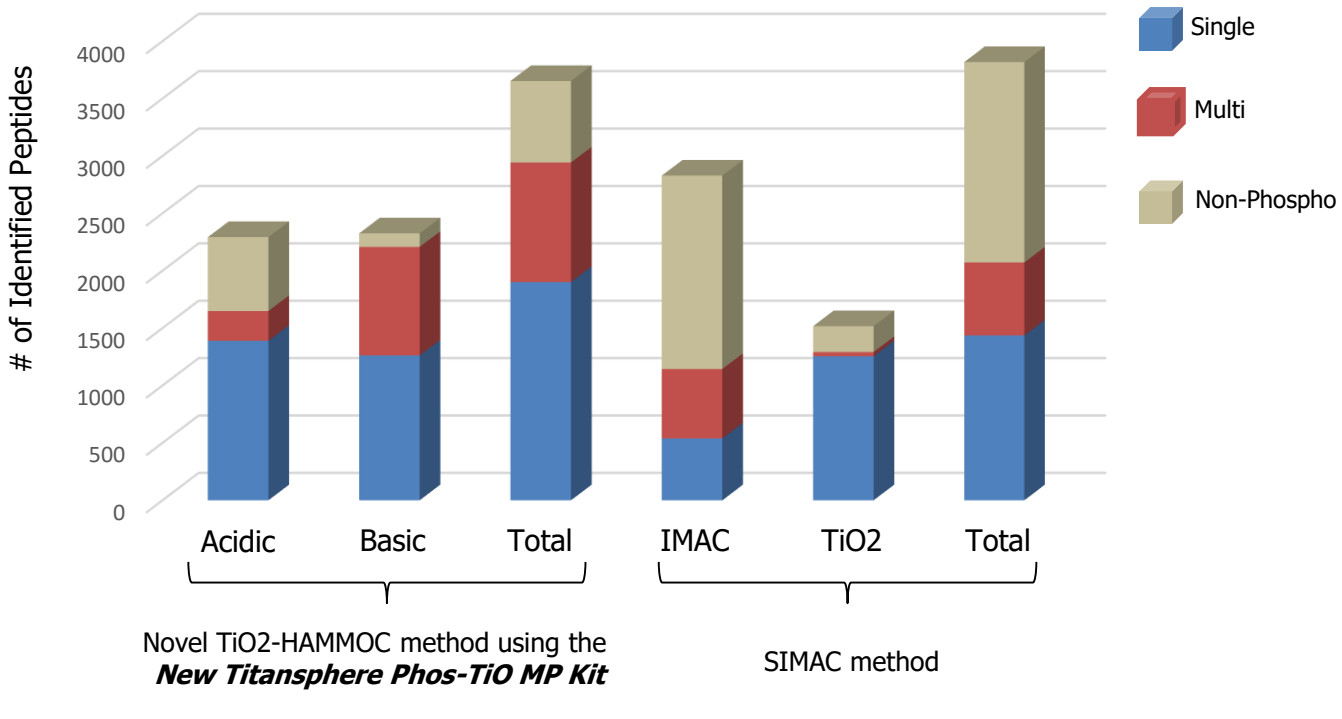
Sample Loading Capacity

Description	Content	
Sample	Tyr(PO_3H_2) - Angiotensin Ⅱ	
Spin Tip Sorbent Mass/Tip Volume	1 mg/ 200 µL	3 mg/200 µL
Sample Loading Capacity	1.2 µg	3.5 µg

Titansphere Phos-TiO MP Kit Contents

Cat. No.	5010-21282	5010-21283
Titansphere Phos-TiO MP Kit	24 pcs	24 pcs
Titansphere Sorbent Mass/Tip Volume	1 mg / 200 µL	3 mg / 200 µL
Spin Tip Quantity	24 pcs (6 x 4 packs)	24 pcs (6 x 4 packs)
Waste Fluid Tube Quantity	24 pcs	24 pcs
Recovery Tube (2.0 mL) Quantity	24 pcs	48 pcs
Recovery Tube (1.5 mL) Quantity	48 pcs	48 pcs
Solution B (Lactic acid) Quantity	2 mL	2 mL
Instruction Manual	1/pk	1/pk

Comparison of Recovery of BOTH Singly and Multiply Phosphorylated Peptides



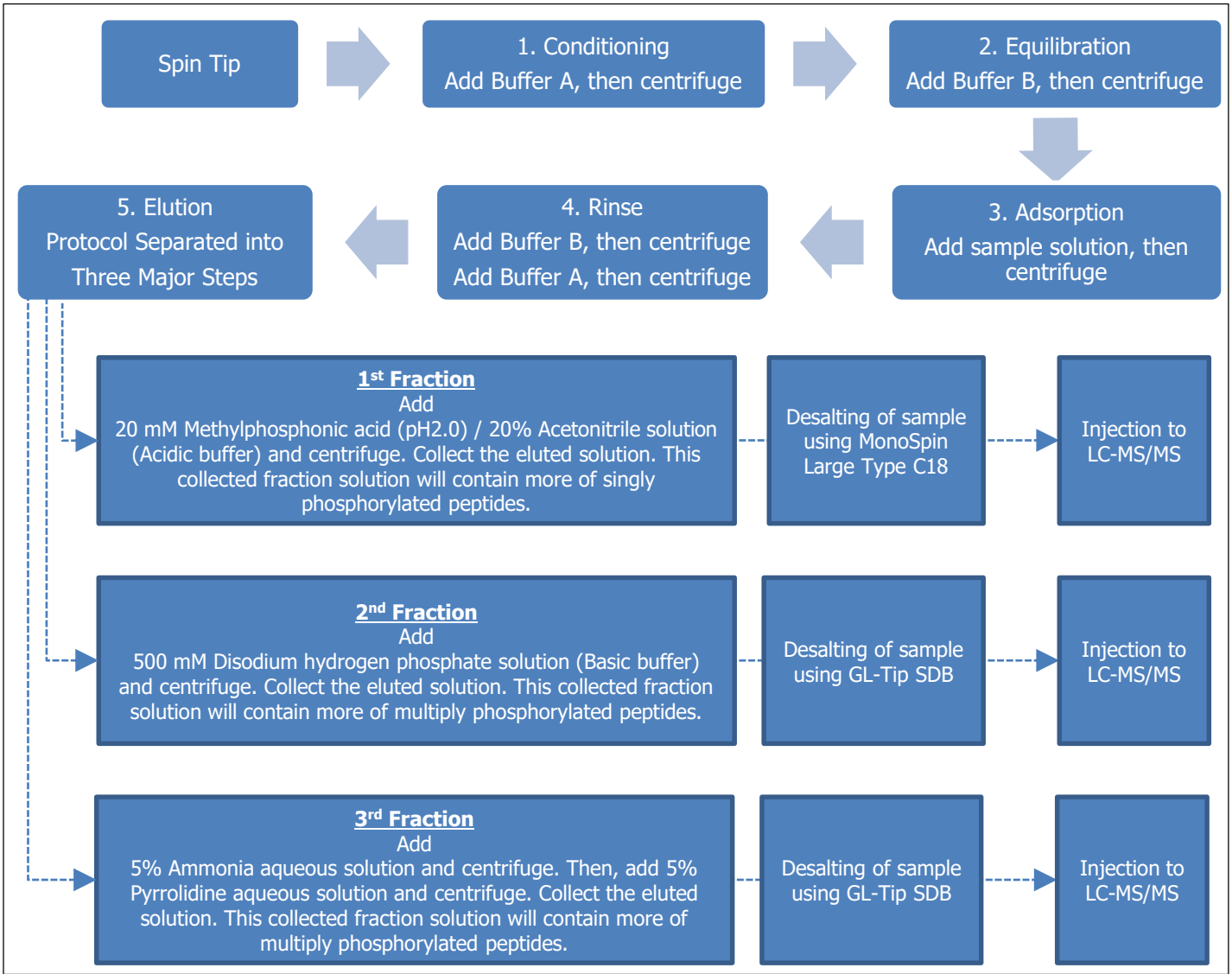
Data from Wakabayashi et al. Ana Chem 2015, 87

The above experiment was done using HeLa cells 100 µg to prove the new Titansphere Phos-TiO MP Kit show highly efficient recovery of both singly and multiply phosphorylated peptides compared to SIMAC (Sequential Elution from IMAC) method.

The SIMAC method is generally separated into two major protocols, which the initial enrichment and separation of mono- and multi-phosphorylated peptides uses an Immobilized Metal ion Affinity Chromatography and a subsequent enrichment of the mono-phosphorylated peptides using titanium dioxide chromatography. Finally, the two separated phosphopeptide fractions are then analyzed by LC-MS/MS.

In the new Titansphere Phos-TiO MP Kit, singly phosphorylated peptides were recovered more when using an acidic elution buffer, while the multiply phosphorylated peptides were recovered more when using a basic elution buffer. As proven above, in total, the new Titansphere Phos-TiO MP Kit recovered more of both singly and multiply phosphorylated peptides than the SIMAC method.

Typical Enrichment Protocol using Titansphere Phos-TiO MP Kit



Remarks:

- Buffer A, Buffer B, Methylphosphonic acid, Disodium hydrogen phosphate, Ammonia aqueous solution and 5% Pyrrolidine aqueous solution are not included in the kit due to their designation as hazardous materials for the purposes of air transportation. Therefore, the user must prepare these solutions in their lab, according to the procedure detailed in the instruction manual.
- Solution B is included in the kit, which is Lactic acid.
- The preparation procedure of Buffer A and B are as follows.

Buffer A	2% TFA solution	1mL
	Acetonitrile	4mL
	Total	5mL（Use 3mL for making Buffer B）

Buffer B	Solution B	1mL
	Buffer A	3mL
	Total	4mL

Ordering Information

Titansphere™ Phos-TiO MP Kit

- Centrifuge Adapter, 24 pcs/pk (Cat. No. 5010-21514) must be purchased once to use the Titansphere Phos-TiO MP Kit.
- This centrifuge adapter is reusable.
- Lactic acid is Solution B, which is already included in the kit, however, can be purchased separately for future requirements.

Description	Sorbent Mass/Tip Volume	Quantity	Cat. No.
Titansphere Phos-TiO MP Kit	1 mg / 200 mL	24 pcs	5010-21282
	3 mg / 200 mL	24 pcs	5010-21283
Centrifuge Adapter	-	24 pcs	5010-21514
Lactic acid for Titansphere Phos-TiO (This is Solution B included in the kit)	15 mL	1/pk	5010-21295

Titansphere Phos-TiO MP Kit with Desalting Columns

- These special packages includes optimized desalting columns/spin tips to be used with Phos-TiO MP Kit.

Package Contents	Package Cat. No.
Titansphere Phos-TiO MP Kit, 1mg /200 mL, 24 pcs/pk (Cat. No. 5010-21282)	5010-21272
MonoSpin Large type C18, 30 pcs/pk (Cat. No. 7510-11320)	
GL-Tip SDB, 96 pcs/pk (Cat. No. 7820-11200)	

Package Contents	Package Cat. No.
Titansphere Phos-TiO MP Kit, 3mg /200 mL, 24 pcs/pk (Cat. No. 5010-21283)	5010-21273
MonoSpin Large type C18, 30 pcs/pk (Cat. No. 7510-11320)	
GL-Tip SDB, 96 pcs/pk (Cat. No. 7820-11200)	

Titansphere Phos-TiO Spin Tips

- Spin tips are also available separately.

Description	Sorbent Mass/Tip Volume	Quantity	Cat. No.
Titansphere Phos-TiO Spin Tips	1 mg / 200 µL	24 pcs	5010-21316
		96 pcs	5010-21317
	3 mg / 200 µL	24 pcs	5010-21307
		96 pcs	5010-21308

Titansphere™ Phos-TiO Kit (Previous Version)

Enrichment of Phosphopeptide Using Spin Tips

This is the previous phosphopeptide enrichment kit that GL Sciences introduced to the market, which became the most popular kit worldwide. The titanium dioxide particles contained in the spin tips (available in 1 mg/10 µL and 3 mg/200 µL sizes) is specially treated to maximize selectivity for phosphorylated species, and the conditioning and washing buffers contain components to displace the few non-phosphorylated compounds which might originally adhere to the media.

Features

- High Recovery of Singly Phosphorylated Peptides.
- All Operation is done using an Easy-To-Use Centrifuge.

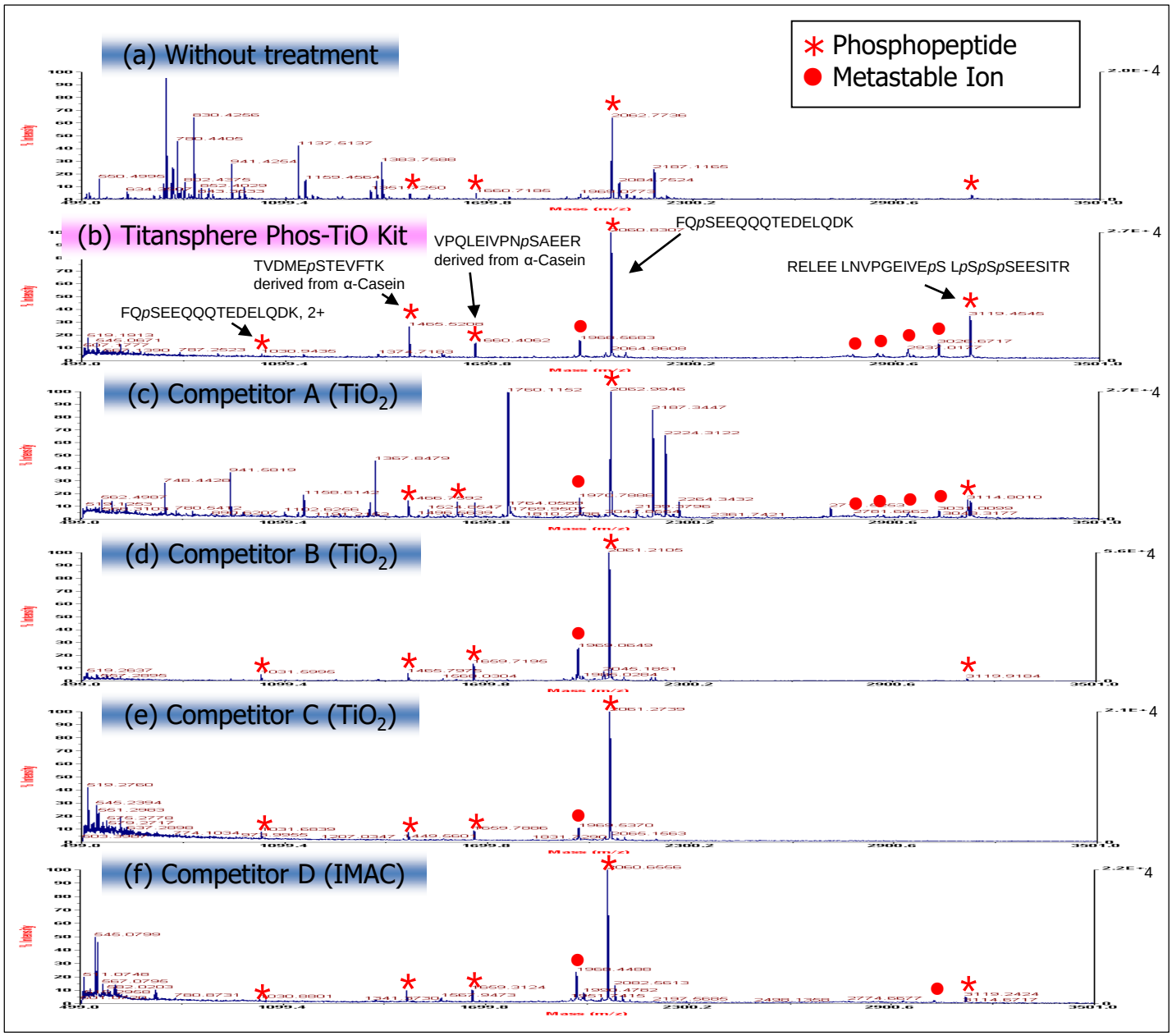
Sample Loading Capacity

Description	Content	
Sample	Tyr(PO_3H_2) - Angiotensin Ⅱ	
Spin Tip Sorbent Mass/Tip Volume	1 mg/ 10 µL	3 mg/200 µL
Sample Loading Capacity	1.2 µg	3.5 µg

Titansphere Phos-TiO Kit Contents

Cat. No.	5010-21309	5010-21310	5010-21311	5010-21312
Titansphere Phos-TiO Kit for Export	24 pcs	96 pcs	24 pcs	96 pcs
Titansphere Sorbent mass/Tip Volume	1 mg / 10 µL		3 mg / 200 µL	
Spin Tip Quantity	24 pcs (6 x 4 packs)	96 pcs (6 x 16 packs)	24 pcs (6 x 4 packs)	96 pcs (6 x 16 packs)
Waste Fluid Tube Quantity	24 pcs	96 pcs	24 pcs	96 pcs
Recovery Tube Quantity	24 pcs	96 pcs	24 pcs	96 pcs
Solution B (Lactic acid) Quantity	2 mL	6 mL	2 mL	6 mL
Instruction Manual	1/pk	1/pk	1/pk	1/pk

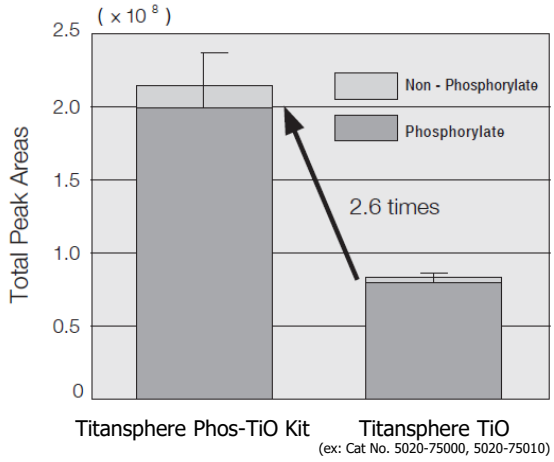
Phos-TiO Kits Outperform 4 Competitive TiO Based Products (MALDI-TOF/MS)



The data above show the purification efficiency of various TiO based products with a 2.5 µg sample of B-casein digest using MALDI-TOF/MS. Compared to the untreated condition (a), phosphopeptides were selectively purified when using Titansphere Phos-TiO Kit. Compared to competitive products (c to e) Titanpshere Phos-TiO Kit showed better selectivity. In general titanium dioxide is said that it has the worse adsorption efficiency of multi-phosphopeptides than IMAC. However, Titansphere Phos-TiO Kit showed higher selectivity, sensitivity and number of individual phosphopeptides isolated for 4 – phosphopeptides than IMAC (f). Metastable ion is a dephosphorylated peak.

Comparison between GL Sciences' Previous Version Bulk Media

Optimal TiO beads (Titansphere Phos-TiO Bulk 10um, Cat No. 5010-21315) are used for Titansphere Phos-TiO Kit. The existing Titansphere TiO bulk media were improved for better adsorption capacity of phosphopeptides. Compared to the existing Titansphere bulk media (ex: Cat No. 5020-75000, 5020-75010), Phos-TiO Kit showed 2.6 times more peak area and 1.6 times more identified phosphopeptides.



Sample: HeLa Cell Lysate
Sample Volume: 50 µg
Titansphere TiO Media: 1 mg

Identified Numbers of Phosphopeptides

Product	Phosphorylate	Non-Phosphorylate
Titansphere Phos-TiO Kit	996	185
Titansphere TiO Bulk Media (ex: Cat No. 5020-75000, 5020-75010)	635	71

Ordering Information

Titansphere™ Phos-TiO Kit

- Centrifuge Adapter, 24 pcs/pk (Cat. No. 5010-21514) must be purchased once to use the Titansphere Phos-TiO Kit.
- This centrifuge adapter is reusable.
- Lactic acid is Solution B, which is already included in the kit, however, can be purchased separately for future requirements.

Description	Sorbent Mass/Tip Volume	Quantity	Cat. No.
Titansphere Phos-TiO Kit	1 mg / 10 µL	24 pcs	5010-21309
		96 pcs	5010-21310
Titansphere Phos-TiO Kit	3 mg / 200 µL	24 pcs	5010-21311
		96 pcs	5010-21312
Centrifuge Adapter	-	24 pcs	5010-21514
Lactic acid for Titansphere Phos-TiO (This is Solution B included in the kit)	15 mL	1/pk	5010-21295

Titansphere Phos-TiO Spin Tips

- Spin tips are also available separately.

Description	Sorbent Mass/Tip Volume	Quantity	Cat. No.
Titansphere Phos-TiO Spin Tips	1 mg / 10 µL	24 pcs	5010-21302
		96 pcs	5010-21303
	3 mg / 200 µL	24 pcs	5010-21307
		96 pcs	5010-21308

Titansphere™ Phos-TiO for Large Volume Samples

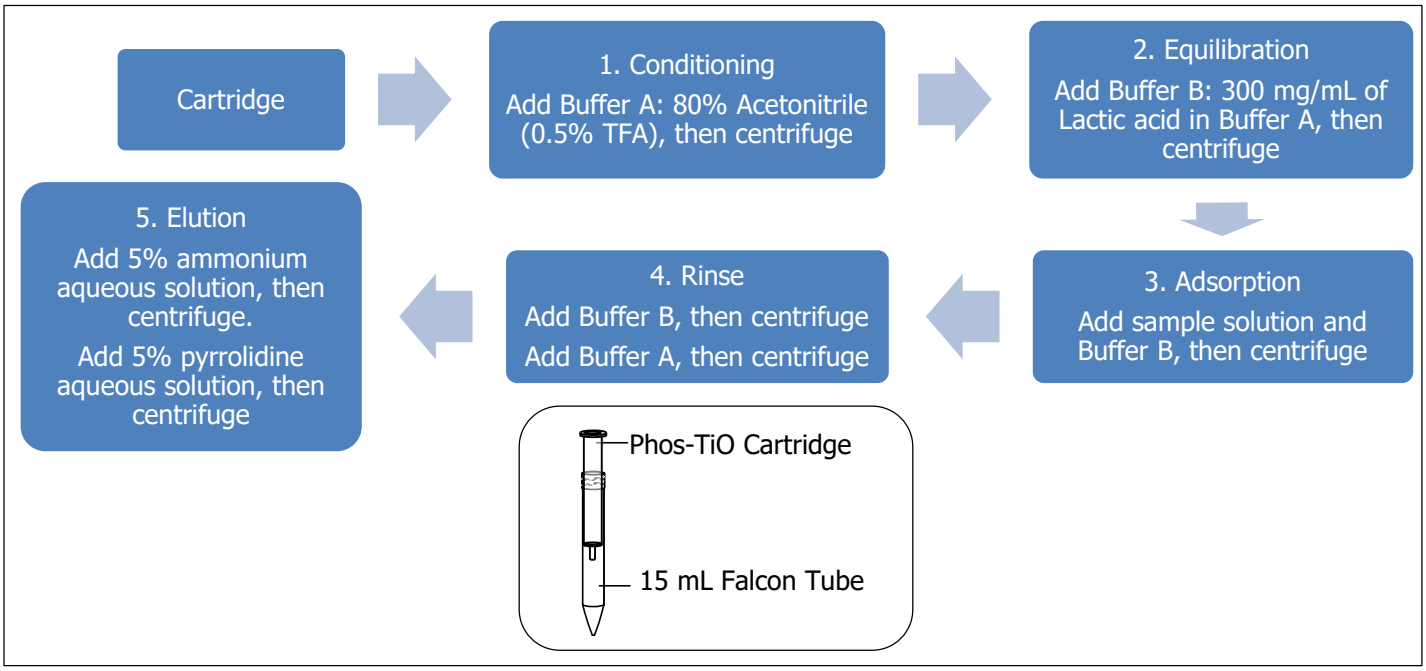
Appropriate for Larger Scale/Volume Purifications

The same specialized bulk media used in our Phos-TiO Kit is available in 50 mg/3 mL and 100 mg/3 mL cartridges as an extension of the Phos-TiO product line.

Sample Loading Capacity

Description	Content	
Sample	Tyr(PO_3H_2) - Angiotensin Ⅱ	
Spin Tip Sorbent Mass/Tip Volume	50 mg/3 mL	100 mg/ 3 mL
Sample Loading Capacity	50 μg	100 μg

Typical Enrichment Protocol using Titansphere Phos-TiO for Large Volume Samples



Phos-TiO for Large Volume Samples Cartridges are intended for use with a desktop or other centrifuge. While some of the versions of Phos-TiO are resemble pipette tips or SPE cartridges, these products are not intended for use with pipettes or SPE vacuum manifolds; the cartridge internal configuration and particle size of the TiO bulk media requires centrifugal elution of all solutions.

Ordering Information

Titansphere™ Phos-TiO for Large Volume Samples

Description	Sorbent Mass/Tip Volume	Qty	Cat. No.
Titansphere Phos-TiO	50 mg/3 mL	25 pcs	5010-21290
for Large Volume Samples	100 mg/3 mL	25 pcs	5010-21291

GL-Tip SDB and GL-Tip GC

Desalting Phosphopeptide-Enriched Samples Prior to LC-MS/MS

Phosphopeptides isolated using TiO2-based medias are typically desalted prior to analysis by LC-MS/MS, typically using a C18 (hydrophobic) micropipette tip. GL Sciences' SDB (styrene divinylbenzene) and GC (graphite carbon) centrifuge-operated micropipette GL-Tip retain more hydrophobic and hydrophilic peptides, respectively, than C18-based tips.

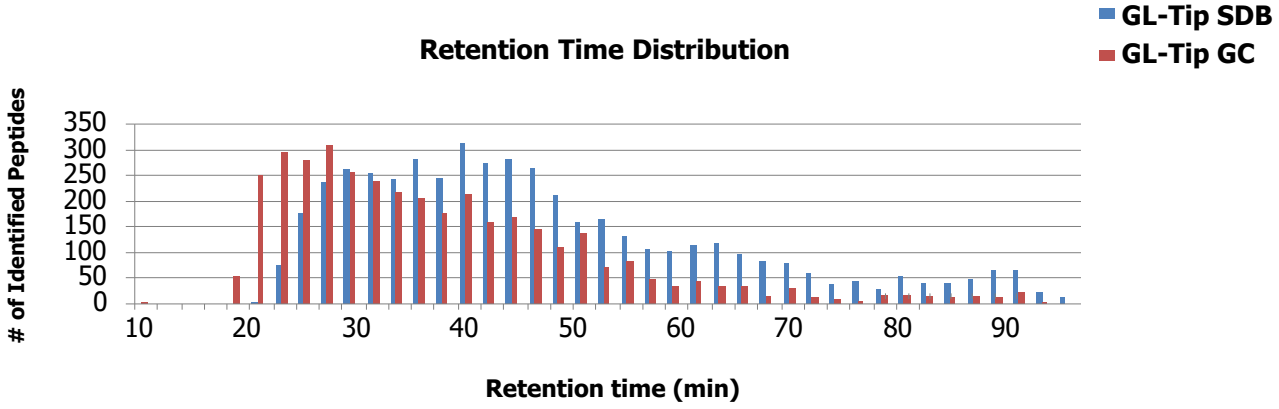
Features

GL-Tip SDB are more hydrophobic than C18 medias and allow retention of a wider range of phosphopeptides with high yield, allowing more accurate analysis of phosphopeptides species present in the sample. GL-Tip GC retain many more hydrophilic phosphopeptides than does C18; by using a combination of GL-Tip SDB and GC, almost all peptide samples can be desalted without sample losses due to lack of retention. Another highlight of this product is, the operation is very easy-to-use. Phosphopeptide-enriched samples are easily loaded, washed, and eluted using the same centrifuge-based technique used with Phos-TiO spin tips.

Sample Loading Capacity

Description	GL-Tip SDB	GL-Tip GC
Sample	Tyr(PO_3H_2) - Angiotensin Ⅱ	Gly-Gly-Tyr-Arg
Spin Tip Sorbent Mass/Tip Volume	200 µL	1 mg/200 µL
Sample Loading Capacity	60 µg	30 µg

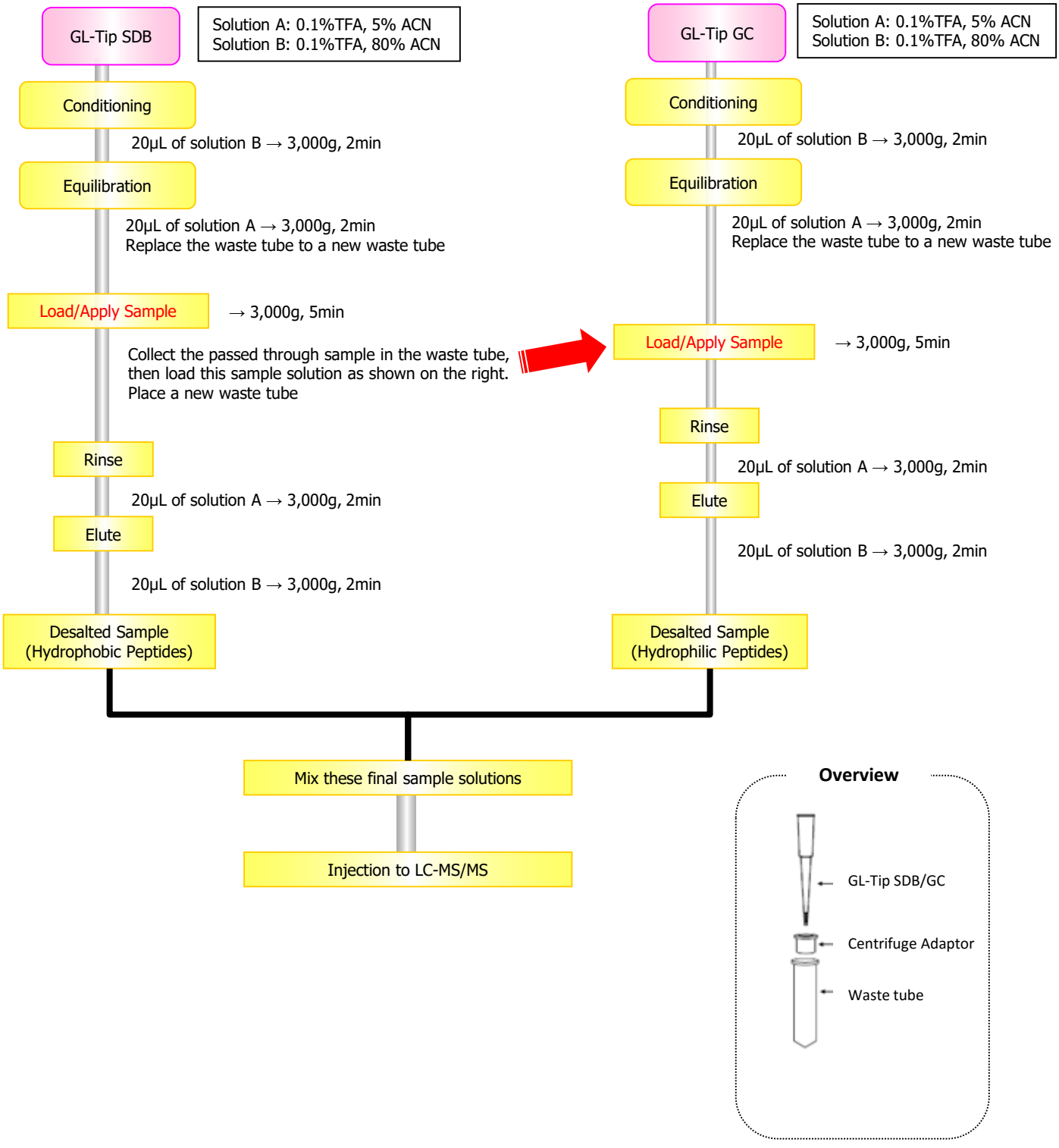
Relative Retention of Peptides Collected using GL-Tip SDB and GC Desalting Tips



Data provided by Dr. Sugiyama, Keio University

As illustrated above, the data indicating that GL-Tip SDB preferentially binds hydrophobic peptides while GC preferentially binds hydrophilic peptides.

Recommended Protocol using GL-Tip SDB and GL-Tip GC



Ordering Information

GL-Tip SDB and GL-Tip GC

- Centrifuge Adapter, 24 pcs/pk (Cat. No. 5010-21514) must be purchased once to use the GL-Tip SDB and GL-Tip GC desalting spin tips.
- This centrifuge adapter is reusable.

Description	Tip Volume	Qty	Cat. No.
GL-Tip SDB	200 µL	96 pcs	7820-11200
GL-Tip GC	200 µL	96 pcs	7820-11201
Centrifuge Adapter	-	24 pcs	5010-21514

GL-Tip SCX and GL-Tip SDB-SCX

Spin Tips for Peptide Fractionation

GL-Tip SCX is packed with strong cation polymer (SCX) and GL-Tip SDB-SCX are packed with styrene divinylbenzene polymer (SDB) and strong cation polymer (SCX). GL-Tip SDB-SCX is packed in a two layer format consisting an SDB and SCX media. Undesalted peptide samples can be used in GL-Tip SDB-SCX as the first SDB layer can desalt the sample.

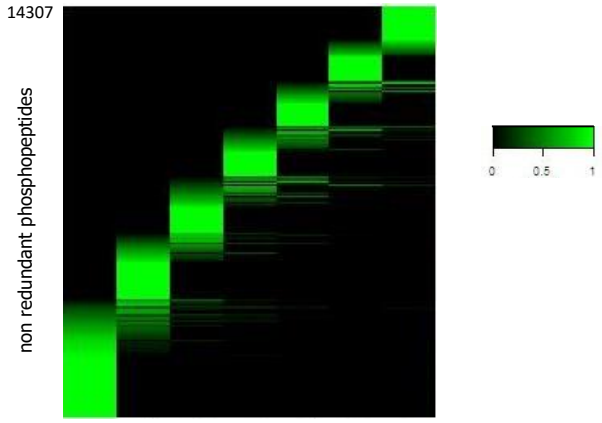
Sample Loading Capacity

Description	GL-Tip SCX	GL-Tip SDB-SCX
Sample	Angiotensin Ⅱ	Angiotensin Ⅱ
Tip Volume	200 µL	200 µL
Sample Loading Capacity	60 µg	60 µg

Comparison of Traditional Gradient Elution vs TFA Gradient Elution

Comparison of Efficiency between Traditional Gradient Elution vs TFA Gradient Elution using DLD-1 Human Large Intestinal Cancer Cell derived Phosphopeptides

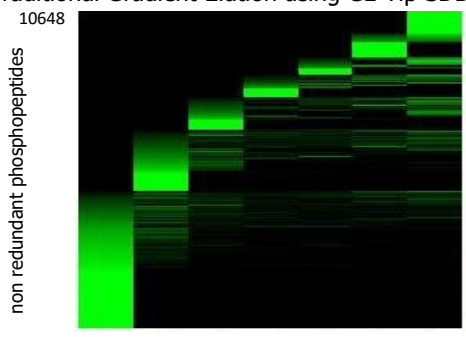
<NEW TFA Gradient Elution using GL-Tip SDB-SCX>



Fraction	1	2	3	4	5	6	7
TFA (%)	0	1	2	3	3	4	0
Ammonium acetate (mM)	0	0	0	0	100	500	500

Concentration in elution buffer

<Traditional Gradient Elution using GL-Tip SDB-SCX >



Fraction	1	2	3	4	5	6	7
Ammonium acetate (mM)	20	50	75	125	200	500	0
NH_4OH (%)	0	0	0	0	0	0	0.1

Concentration in elution buffer

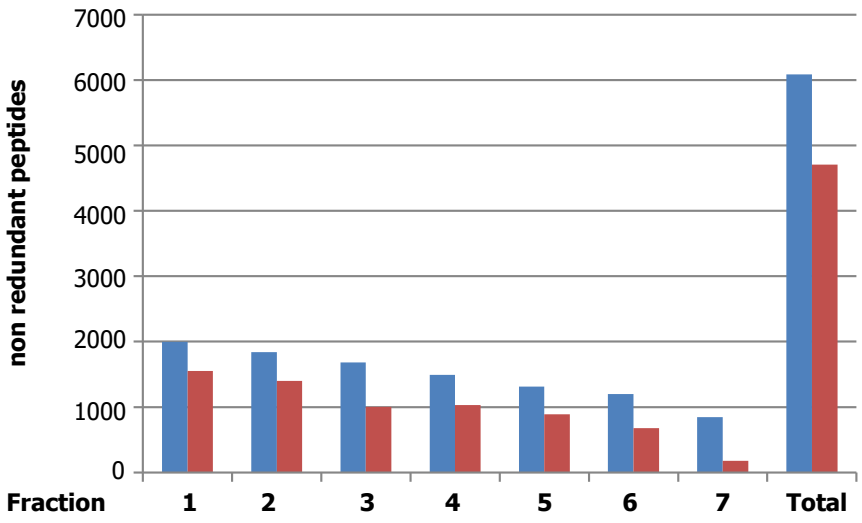
As proven above, the newly developed TFA gradient elution identified 14307 peptides promising higher efficiency than the traditional gradient elution method.

(Data provided from the National Institute of Biomedical Innovation, Dr. Jun Adachi)

A gradient elution using cation SCX media is commonly used in shotgun proteomics to fractionate peptide samples from complex samples such as cell or tissue extracts. The biggest challenge arises when identifying the same peptide from one fractionated peptide sample to another, which results in lowering efficiency. The newly developed TFA gradient elution method (patent applied) identifies more peptides without decreasing operation efficiency.

Comparison of Number of Quantified Peptides

Compared results between commercially available brand G's tip column. GL-Tip SCX recovered more peptides. The usage of the newly developed TFA gradient elution method provide less chance of identifying the same peptide from one fractionated sample peptide to another resulting in higher efficiency.



Sample/Procedure:
Trypsin digestion of HeLa cell lysate 25 µg each were fractionated and 40% of the recovered sample were identified via LTQ-Orbitrap XL, 45 minutes gradient using Maxquant 1.5.1.2, uniprot human database.

Number of Identified Non Redundant Peptides

Fractions	1	2	3	4	5	6	7	total
GL-Tip SCX	1996	1839	1684	1491	1311	1196	847	6085
Brand G	1552	1397	1004	1032	890	676	179	4704

(Data provided from the National Institute of Biomedical Innovation, Dr. Jun Adachi)

Ordering Information

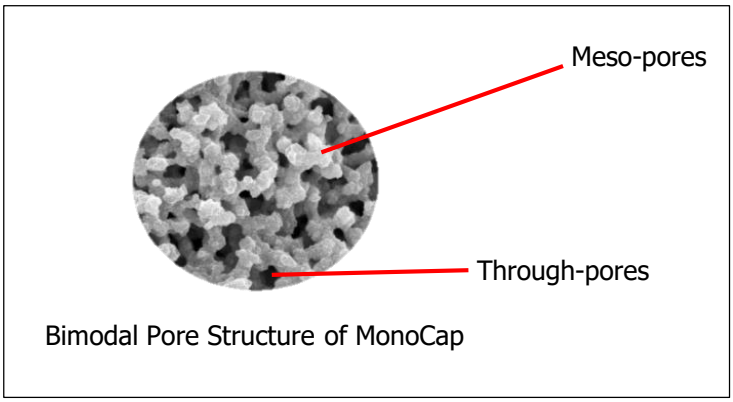
GL-Tip SCX and GL-Tip SDB-SCX

- Centrifuge Adapter, 24 pcs/pk (Cat. No. 5010-21514) must be purchased once to use the GL-Tip SCX and GL-Tip SDB-SCX peptide fractionation spin tips.
- This centrifuge adapter is reusable.

Description	Tip Volume	Qty	Cat. No.
GL-Tip SCX	200 µL	96 pcs	7510-11203
GL-Tip SDB-SCX	200 µL	96 pcs	7510-11202
Centrifuge Adapter	-	24 pcs	5010-21514
Centrifuge Adapter for 96-Well Plate	-	1/pk	5010-21341
Centrifuge Adapter for 96-Well Plate	-	2 pcs	5010-21343

MonoCap HighResolution 2000 Series

Optimized for Identification of Peptides/Proteins for Proteome Research



Bimodal Pore Structure of MonoCap

MonoCap HighResolution 2000 is a 2 meter length monolithic silica capillary column which is designed for identifying extremely high number of peptides/proteins for proteome research via LC-MS/MS.

GL Sciences' MonoCap capillary columns, created synthetically via sol-gel method, and an octadecyl silane chemically bonded, has a very uniform three dimensional structure that shows excellent reproducibility from batch-to-batch.
The solid structure of GL Sciences' monolithic silica eliminates the need for frits or filters at the ends of the column, thereby reducing dead volume that might otherwise lead to band broadening or sample recovery.
The high porosity of our monolithic silica allows high flow rates to be used without loss of resolution or creation of high operating pressure. An optimized balance of through-pores and meso-pores provides the critically important combination of efficiency, separation speed, large volume sample-loading, and small volume sample-recovery.

MonoCap HighResolution provide extremely high efficiency, delivering over 200,000 plates for a 2,000 mm length column. The MonoCap HighResolution Ultra type deliver over 300,000 plates.

Physical Properties

Product Description	Bonded Phase	Meso-pore	End-capping	Max. Operating Pressure
MonoCap C18 HighResolution 2000	Octadecyl Groups	15 nm	Yes	35 MPa
MonoCap C18 HighResolution Ultra 2000	Octadecyl Groups	11 nm	Yes	35 MPa
MonoCap HILIC-UP HighResolution 2000	Ureidopropyl Groups	12 nm	None	35 MPa

Based on monolithic technology, Merck KGaA, Darmstadt, Germany.

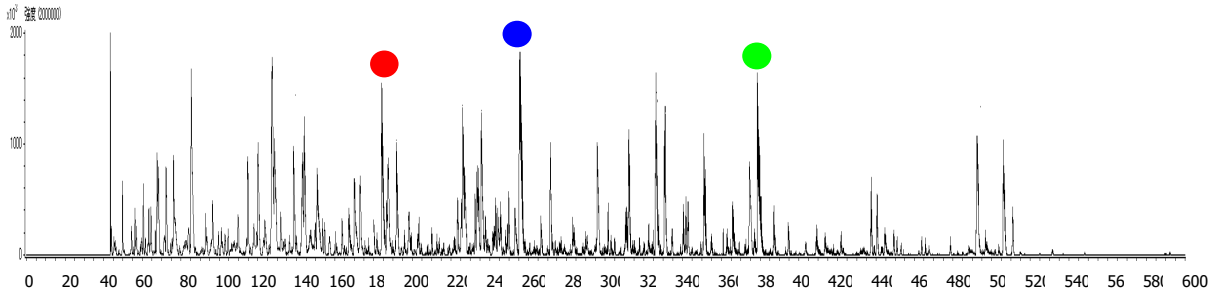
Discover New Peptides/Proteins

As proven below, MonoCap C18 HighResolution 2000 mm length column identifies simply more peptides/proteins compared to those traditional particle packed capillary HPLC columns.

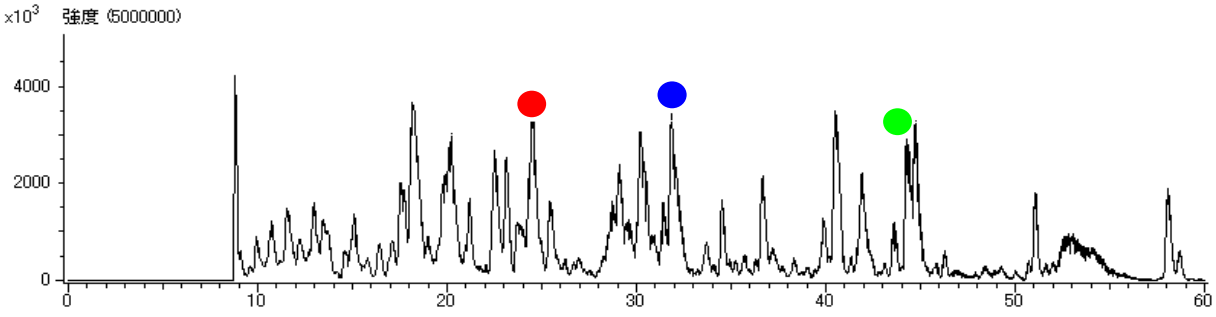
MS: **LTQ-Orbitrap XL (Mascot Search)**
Sample: **THP-1 Cell Lysate Tryptic Digest, 5 µg**

Column Name	Number of Identified Proteins in average	Analysis Time
MonoCap C18 HighResolution 2000 0.1 mm I.D. x 2000 mm	**2,087 (2013, 2116, 2131)**	**10 Hours**
Particle packed column 0.1 mm I.D. x 150 mm	680 (685, 679, 675)	2 Hours

[1] MonoCap C18 HighResolution 2000 (2000 mm x 0.1 mm I.D.)



[2] Particle Packed column (3 µm , 150 mm x 0.075 mm I.D.)



Conditions

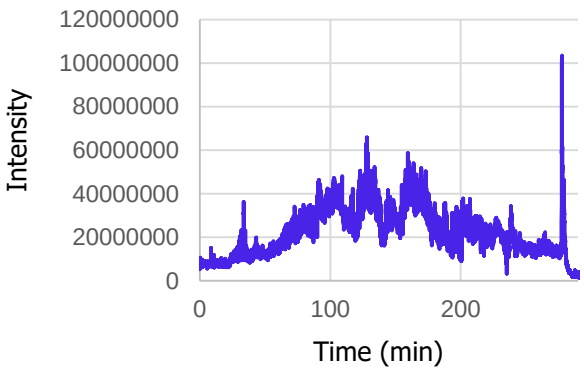
System : GLS Capillary HPLC system
Column : [1] MonoCap C18 High Resolution 2000 (2000 mm x 0.1 mm I.D)
: [2] Particle packed column (3 µm, 150 mm x 0.075 mm I.D.)
Trap column : MonoCap C18 Trap Column (50 mm x 0.075 mm I.D.)
Eluent : A) 0.1 %HCOOH in CH_3CN
B) 0.1 %HCOOH in H_2O
[1] A / B = 10 / 90 - 600 min - 45 / 55
[2] A / B = 10 / 90 - 180 min - 45 / 55

Flow Rate : [1] 0.5 µL/min
[2] 0.3 µL/min
Injection Vol.: 5 µL
Detection : MS (TIC m / z 500-1500)
Sample : Tryptic digest of proteins

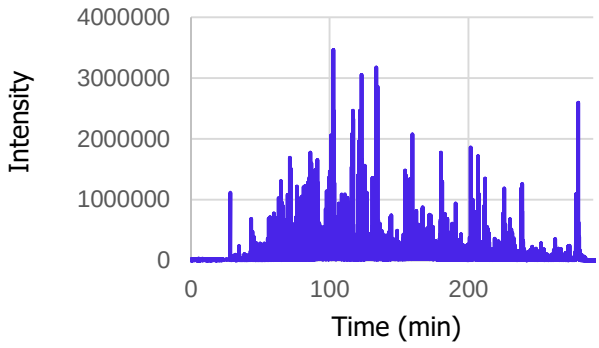
● ● ● **are analytes having the same molecular weight**

For Identifying Highly Hydrophilic, Hydrophobic Peptides/Proteins

MonoCap HILIC-UP is an important addition to the MonoCap C18 HighResolution 2000 column series. MonoCap HILIC-UP can retain highly hydrophilic peptides/proteins which may lead to discovering new peptides/proteins where a C18 phase couldn't identify.
In HILIC, the higher the organic concentration, the greater the retention of more polar analytes. One of the biggest benefit of HILIC mode is, a high organic solvent concentration of the mobile phase will lead to a high sensitivity LC-MS/MS analysis.



Total Ion Chromatogram



Base Peak Chromatogram

Remarks:

Results of MonoCap C18 HighResolution 2000

Number of Identified Peptides: 8,358
Number of Identified Proteins: 1,992
Gradient Program: 4 hrs

Results of MonoCap HILIC-UP HighResolution 2000

Number of Identified Peptides: 7,194 (14,736 PSM*)
Number of Identified Proteins: 2,201
*** Peptide Spectrum Match**

Conditions

Column	: MonoCap HILIC-UP High Resolution 2000
Eluent	: A) CH_3CN : H_2O=10/90 (0.5% CH_3COOH)
	B) CH_3CN : H_2O=95/5 (0.5% CH_3COOH)
	A/B=0/100-(240 min)-20/80-(10 min)-100/0-(10 min)-100/0
Flow Rate	: 0.5 µL
Injection Vol.	: 1 µL (1 mg/mL)
Detection	: TIC MS (m/z 300-1500)
Sample	: Tryptic Digest of Hela Cell Lysate, 5 ug

Reference:
Hydrophilic Interaction Chromatography Using a Meter-Scale Monolithic silica capillary Column for Proteomics LC-MS,
K Horie et al. *Anal. Chem*. 2014, 86, 3817-3824

References

1. M.H.M. van de Meent et al.
Improvement of the liquid-chromatographic analysis of protein tryptic digests by the use of long-capillary monolithic columns with UV and MS detection, Anal Bioanal Chem, 2007,388, 195-200

2. Mio Iwasaki et al.
One-Dimensional Capillary Liquid Chromatographic Separation Coupled with Tandem Mass Spectorometry Unveils the Escherichia coli Proteome on a Microarray Scale, Anal. Chem. 2010, 82, 2616-2620

3. Mio Iwasaki et al.
Human Proteome analysis by using reversed phase monolithic silica capillary columns with enhanced sensitivity, J Chromatogr A 2012, 1228, 292-297

4. Ryota Yamana ea al.
Rapid and deep profiling of human induced pluripotent stem cell proteome by one-shot NanoLC-MS/MS analysis with meter-scale monolithic silica columns, J Proteome Res. 2013, 12, 214-21

5. Mari Ogawa-Ohnishi et al.
Identification of three hydroxyproline O-arabinosyltransferases in Arabidopsis thaliana, Nature Chem. Biol. 2013, 9, 726-730

6. Satoru Okamoto et al.
Root-derived CLE glycopeptides control nodulation by direct binding to HAR1 receptor kinase, Nature Commun. 2013,4, 2191

7. Kanta Horie et al.
Hydrophilic interaction chromatography using a meter-scale monolithic silica capillary column for proteomics LC-MS, Anal. Chem. 2014, 86, 3817-3824

Ordering Information

MonoCap C18 HighResolution Ultra 2000

- End-fittings are not included.
- A column connection kit is available separately to ensure proper connections.
- Please refer to the below ordering information.

Description	I.D. (mm)	Length (mm)	Qty	Cat. No.
MonoCap C18 HighResolution Ultra 2000	10 µm	2000	1/pk	5020-10018

MonoCap C18 HighResolution 2000

- End-fittings are not included.
- A column connection kit is available separately to ensure proper connections.
- Please refer to the below ordering information.

Description	I.D. (mm)	Length (mm)	Qty	Cat. No.
MonoCap C18 HighResolution 2000	10 µm	2000	1/pk	5020-10015

MonoCap HILIC-UP HighResolution 2000

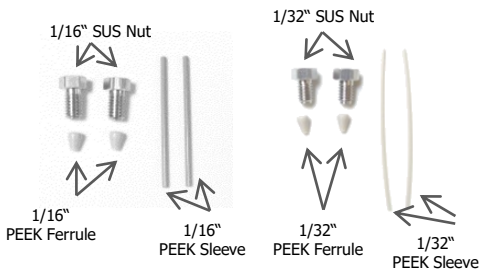
- End-fittings are not included.
- A column connection kit is available separately to ensure proper connections.
- Please refer to the below ordering information.

Description	I.D. (mm)	Length (mm)	Qty	Cat. No.
MonoCap HILIC-UP HighResolution 2000	10 µm	2000	1/pk	5020-10019

Connection Kit for MonoCap HighResolution 2000

- A dedicated connection kit for MonoCap C18 High Resolution 2000.
- Use this connection kit when connecting the column directly to the system.

Description	Qty	Cat. No.
1/16" PEEK Ferrule, SUS Nut, Sleeve, 2 pcs each. 1/32" PEEK Ferrule, SUS Nut, Sleeve, 2 pcs each.	1/pk	5020-10017



Zero Dead Volume Union

- Connect the tubing from the system to this union and install the column to achieve zero dead volume.

Description	Orifice Size	Qty	Cat. No.
U-435	0.25 mm	1/pk	6010-72352
U-411	178 µm	1/pk	6010-72351

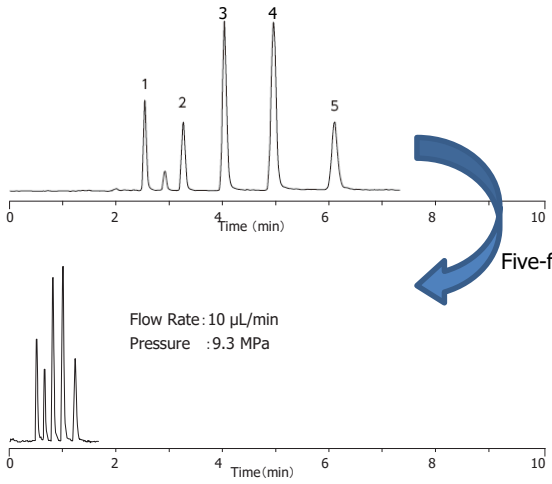
MonoCap C18 Fast-Flow

Physical Properties

Product Description	Bonded Phase	Meso-pore	End-capping	Max. Operating Pressure
MonoCap C18 Fast-flow	Octadecyl Groups	15 nm	Yes	22 MPa

Workable at a broad range of linear velocity from 0.5 to 5 mm/s without sacrificing efficiency and separation at high speed. The number of theoretical plates produced by MonoCap C18 Fast-Flow is nearly equivalent to a totally porous particle type capillary column packed with a 5 µm packing material. Columns are protected by either metal or PEEK hardware.

Workable at High Flow Rates without Sacrificing Efficiency



Conditions

Column : MonoCap C18 for Fast-flow (150 × 0.2 mm I.D.)
Eluent : A) CH_3CN B) H_2O A/B=50/50 ,v/v
Col.Temp. Ambient
Detection : UV 210 nm (MU701, Cell Volume 18 nL)
Injection Vol. : 0.5 µL
Sample : 1. Thiourea
2. Acetophenone
3. Benzene
4. Toluene
5. Naphthalene

MonoCap C18 Nano-flow

Physical Properties

Product Description	Bonded Phase	Meso-pore	End-capping	Max. Operating Pressure
MonoCap C18 Nano-flow	Octadecyl Groups	11 nm	Yes	22 MPa

MonoCap C18 Nano-flow produces higher number of theoretical plates compared to a totally porous particle type capillary column packed with a 3 µm packing material. It can be operated at a wide range of flow rate with low back pressure and achieve very high sensitive results in Nano-LC-ESI/MS applications. Columns are protected by either metal or PEEK hardware.

MonoCap C18 WideBore

Physical Properties

Product Description	Bonded Phase	Meso-pore	End-capping	Max. Operating Pressure
MonoCap C18 WideBore	Octadecyl Groups	11 nm	Yes	22 MPa

The MonoCap C18 Fast-flow is also available in 0.5 mm I.D. size, which can be used at a wide range of flow rate from 6 to 100 µL/min without sacrificing efficiency. The number of theoretical plates produced by MonoCap C18 WideBore is nearly equivalent to a totally porous particle type capillary column packed with a 5 µm packing material. Columns are protected by a metal hardware.

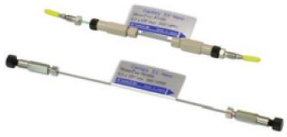
MonoCap C18 Trap Column

Physical Properties

Product Description	Bonded Phase	Meso-pore	End-capping	Max. Operating Pressure
MonoCap C18 Trap Column	Octadecyl Groups	11 nm	Yes	20 MPa

MonoCap C18 Trap columns have a relatively big throughpore and workable at a high flow rate such as 10 µL/min. This benefit makes MonoCap C18 Trap columns to be appropriate for on-line preconcentration or desalting of protein and peptide samples prior to HPLC separation with mass spectrometry detection. End-fittings are 1/16” (10-32 UNF). 1/32” end-fittings are also available upon request.

MonoCap Amide



Physical Properties

Product Description	Bonded Phase	Meso-pore	End-capping	Max. Operating Pressure
MonoCap Amide	Carbamoyl Groups	15 nm	None	22 MPa

Amide groups are chemically bonded to the monolithic silica and makes it suitable for the analysis of sugars via HILIC mode. As the back pressure is significantly low, a 500 mm length MonoCap Amide column deliver over 40,000 plates offering high efficiency. Generally, HILIC mode uses acetonitrile at a concentration between 65-95 % in an aqueous buffer such as ammonium acetate or ammonium formate, which have high solubility in organic solvents. Columns are protected by either metal or PEEK hardware.

MonoCap SCX

Physical Properties

Product Description	Bonded Phase	Meso-pore	End-capping	Max. Operating Pressure
MonoCap SCX	Benzenesulfonyl Groups	11 nm	None	20 MPa

MonoCap SCX is bonded with benzene sulfonic acid groups (strong cation exchange) and appropriate for 2D LC applications for the separation of biomolecules such as peptides and proteins.

Ordering Information

MonoCap C18 Fast-Flow

- For end-fittings information, please refer to page 30.
- All 50 mm length PEEK columns does not come with a hardware and will be supplied with 3 pcs of columns only.

Description	I.D. (mm)	Length (mm)	Hardware	Qty	Cat. No.
MonoCap C18 Fast-Flow	0.05	50	Metal	1/pk	5020-10102
		150		1/pk	5020-10101
		250		1/pk	5020-10100
		50	PEEK	3/pk	5020-10002
		150		1/pk	5020-10001
		250		1/pk	5020-10000
	0.075	50	Metal	1/pk	5020-10211
		150		1/pk	5020-10212
		250		1/pk	5020-10213
		50	PEEK	3/pk	5020-10221
		150		1/pk	5020-10222
		250		1/pk	5020-10223
	0.1	50	Metal	1/pk	5020-10112
		150		1/pk	5020-10111
		250		1/pk	5020-10110
		50	PEEK	3/pk	5020-10012
		150		1/pk	5020-10011
		250		1/pk	5020-10010
	0.2	50	Metal	1/pk	5020-10122
		150		1/pk	5020-10121
		250		1/pk	5020-10120
		50	PEEK	3/pk	5020-10022
		150		1/pk	5020-10021
		250		1/pk	5020-10020

Ordering Information

MonoCap C18 Nano-Flow

- For end-fittings information, please refer to page 30.
- All 50 mm length PEEK columns does not come with a hardware and will be supplied with 3 pcs of columns only.

Description	I.D. (mm)	Length (mm)	Hardware	Qty	Cat. No.
MonoCap C18 Nano-Flow	0.05	50	Metal	1/pk	5020-10143
		150		1/pk	5020-10141
		50	PEEK	3/pk	5020-10043
		150		1/pk	5020-10041
	0.075	50	Metal	1/pk	5020-10231
		150		1/pk	5020-10232
		50	PEEK	3/pk	5020-10241
		150		1/pk	5020-10242
	0.1	50	Metal	1/pk	5020-10153
		150		1/pk	5020-10151
		50	PEEK	3/pk	5020-10053
		150		1/pk	5020-10051
	0.2	50	Metal	1/pk	5020-10163
		150		1/pk	5020-10161
		50	PEEK	3/pk	5020-10063
		150		1/pk	5020-10061

MonoCap C18 WideBore

- For end-fittings information, please refer to page 30.

Description	I.D. (mm)	Length (mm)	Hardware	Qty	Cat. No.
MonoCap C18 WideBore	0.5	50	Metal only	1/pk	5020-10202
		150		1/pk	5020-10201
		250		1/pk	5020-10200

Ordering Information

MonoCap C18 Trap Column

- For end-fittings information, please refer to page 30.

Description	I.D. (mm)	Length (mm)	Hardware	Qty	Cat. No.
MonoCap C18 Trap Column	0.05	50	With Hardware	1/pk	5020-10026
		100		1/pk	5020-10038
		150		1/pk	NA
		50	Without Hardware	1/pk	5020-10027
		100		1/pk	5020-10039
		150		1/pk	NA
	0.075	50	With Hardware	1/pk	5020-10028
		100		1/pk	5020-10036
		150		1/pk	NA
		50	Without Hardware	1/pk	5020-10029
		100		1/pk	5020-10037
		150		1/pk	NA
	0.2	50	With Hardware	1/pk	5020-10033
		100		1/pk	NA
		150		1/pk	NA
		50	Without Hardware	1/pk	5020-10034
		100		1/pk	NA
		150		1/pk	5020-10031

MonoCap Amide

- For end-fittings information, please refer to page 30.

Description	I.D. (mm)	Length (mm)	Hardware	Qty	Cat. No.
MonoCap Amide	0.075	150	Metal	1/pk	5020-10191
		250		1/pk	5020-10192
		500		1/pk	5020-10193
		150	PEEK	1/pk	5020-10091
		250		1/pk	5020-10092
		500		1/pk	5020-10093
	0.1	150	Metal	1/pk	5020-10181
		250		1/pk	5020-10182
		500		1/pk	5020-10183
		150	PEEK	1/pk	5020-10081
		250		1/pk	5020-10082
		500		1/pk	5020-10083
	0.2	150	Metal	1/pk	5020-10171
		250		1/pk	5020-10172
		500		1/pk	5020-10173
		150	PEEK	1/pk	5020-10071
		250		1/pk	5020-10072
		500		1/pk	5020-10073

Ordering Information

MonoCap SCX

- For end-fittings information, please refer to the following information.

Description	I.D. (mm)	Length (mm)	Hardware	Qty	Cat. No.
MonoCap SCX	0.2	50	Metal	1/pk	5020-10174
		150		1/pk	5020-10175
		250		1/pk	5020-10176
		500		1/pk	5020-10177
		50	PEEK	1/pk	5020-10074
		150		1/pk	5020-10075
		250		1/pk	5020-10076
		500		1/pk	5020-10077

End-fittings of MonoCap Monolithic Capillary HPLC Columns

Description	End-fittings Details
MonoCap C18 Fast-flow MonoCap C18 Nano-flow MonoCap C18 WideBore MonoCap Amide MonoCap SCX	1. Metal Hardware Type End-fittings are Valco 1/16" (10-32 UNF). Valco 1/32" (6-40 UNF) end-fittings can also be arranged upon request, indicate "1/32" when ordering. 2. PEEK Hardware Type 1/16" male nut, ferrule and PTFE sleeve are included.

Connection Kit for MonoCap C18 Trap Column

Description	Cat. No.
MonoCap C18 Trap Column Connection Kit 1/16" (Union·Sleeve·Capillary Tubing 2 pcs each, Nut·Ferrule 4 pcs each)	5020-10044
MonoCap C18 Trap Column Connection Kit 1/32" (Union·Sleeve·Capillary Tubing 2 pcs each, Nut·Ferrule 4 pcs each)	5020-10045
MonoCap C18 Trap Column Assembly Parts 1/16" (Nut·Ferrule 4 pcs each)	5020-10046
MonoCap C18 Trap Column Assembly Parts 1/32" (Nut·Ferrule 4 pcs each)	5020-10047

MonoSpray

Monolithic Electrospray Emitter for ESI-LC/MS

MonoSpray is an electrospray emitter for ESI-LC/MS which a monolithic packing is packed into a fused silica sprayer offering numbers of benefits compared to those traditional sprayers packed with particle based packings. Frits are not installed in MonoSpray to keep the monolithic packing in place, which results in offering simply longer lifetime and avoiding bed splitting problems compared to those traditional sprayers packed with particle based packings. The very high porosity of monolithic packing allows a wide range of operational flow rates, even at high flow rates.

Features

- High Sensitivity Analysis
- High Chemical Stability
- High Physical Stability
- Wide Range of Operational Flow Rates

Ordering Information

MonoSpray FS

- For online Nano-ESI-LC/MS.

Description	Length (mm)	O.D. (µm)	I.D. (µm)	Qty	Optimum Flow Rate	Cat. No.
MonoSpray FS	50	370	50	5 pcs	0.1 - 1.0 µL/min	5010-20001
				20 pcs		5010-20006
			75	5 pcs	0.2 - 2.0 µL/min	5010-20002
				20 pcs		5010-20007
			100	5 pcs	1.0 - 5.0 µL/min	5010-20003
				20 pcs		5010-20008

Please inquire for other sizes.

MonoSpray C18 Nano

- Nano sprayer packed with octadecylated silica monolith offering reversed phased separation.

Description	Length (mm)	O.D. (µm)	I.D. (µm)	Qty	Optimum Flow Rate	Cat. No.
MonoSpray C18 Nano	50	370	50	1 pcs	0.1 - 0.5 µL/min	5010-20011
				4 pcs		5010-20016
			75	1 pcs	0.1 - 1.0 µL/min	5010-20012
				4 pcs		5010-20017
			100	1 pcs	0.3 - 2.0 µL/min	5010-20013
				4 pcs		5010-20018

Please inquire for other sizes.

Based on monolithic technology, Merck KGaA, Darmstadt, Germany.

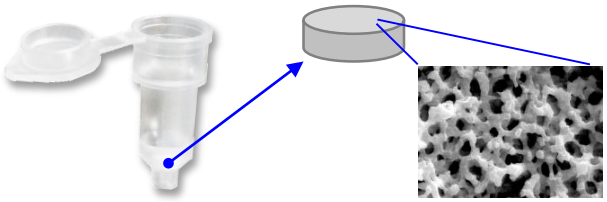
MonoSpin Series

Low-Molecular Compounds Extraction and Purification

The low-pressure, high-flow, and low-liquid-retention properties of GL Sciences' monolith silica technology make it uniquely suited for handling of small samples. MonoSpin SPE centrifugal spin columns have been developed to improve concentration and yields in low-volume sample preparation.

Features

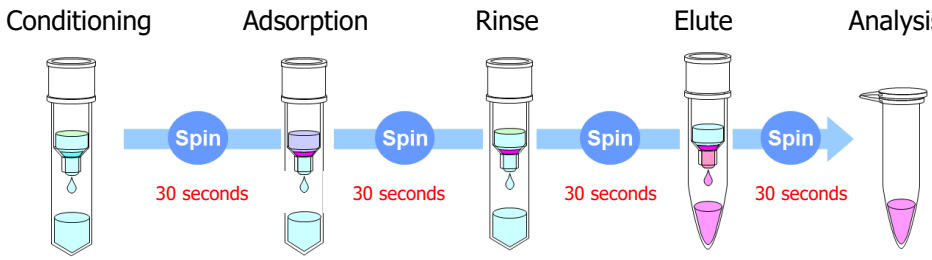
- Easy-to-Operate
- Ideal for Small Sample Volumes
- Wide Variety of Functional Groups
- Rapid Operation Time



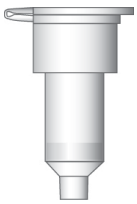
MonoSpin　　Silica Monolith Enlarged View

How to Operate

Centrifuge elution allows loss-free and efficient processing of many samples simultaneously, with little or no liquid retained by the separation matrix. And, excellent mass transfer and rapid sample binding on MonoSpin's monolith silica allows extremely rapid sample preparation compared with other methods.



Formats



S Type (Small)

- Disc Size : φ 4.2 x 1.5 mm
- Sample Volume : 50 ～ 800 µL
- Elution Volume : 50 ～ 800 µL
- Centrifugation Speed : 2,000 ～ 10,000 x *g*

L Type (Large)

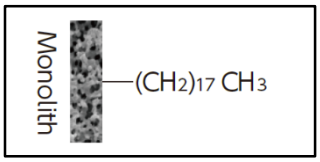
- Disc Size : φ 9 x 3 mm
- Sample Volume : 0.5 ～ 8 mL
- Elution Volume : 0.5 ～ 8 mL
- Centrifugation Speed : 1,000 x *g*

Based on monolithic technology, Merck KGaA, Darmstadt, Germany.

Product Lineup

MonoSpin C18/C18 FF

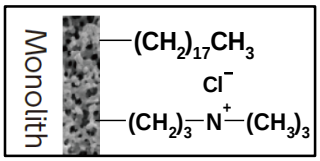
Formats: S L



Octadecyl functional group. Optimal for drug extraction in biological samples, and desalting & enrichment of peptide samples C18 FF type employs large through-pore monolith silica for high viscosity samples.

MonoSpin C18-AX

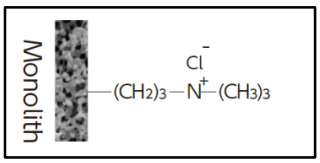
Formats: S



Bonded with octadecyl and trimethylaminopropyl, a mix mode type. Delivers great retention for high salt concentrated serum samples. Optimal for the recovery of acidic drugs.

MonoSpin SAX

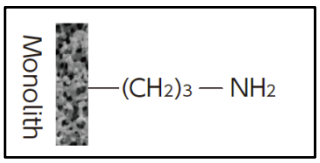
Formats: S L



Bonded with trimethylaminopropyl combining both strong anion exchange & weak hydrophobic interaction. Optimal for the extraction of acidic drugs.

MonoSpin NH2

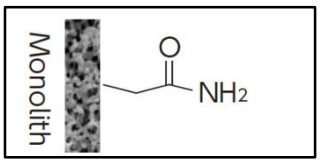
Formats: S L



Bonded with aminopropyl. Optimal for the enrichment of sugar chain and/or hydrophilic compounds by HILIC mode.

MonoSpin Amide

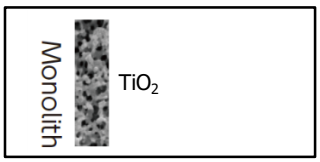
Formats: S



Bonded with amide. Optimal for the extraction of sugar chains and various hydrophilic acidic and basic compounds by HILIC mode.

MonoSpin TiO

Formats: S



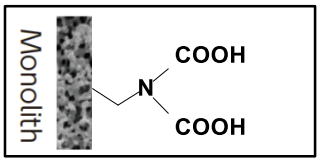
Monolith skeleton coated with titanium dioxide. Excellent for the enrichment of phosphopeptides.

S : Small Type L : Large Type

Product Lineup

MonoSpin ME

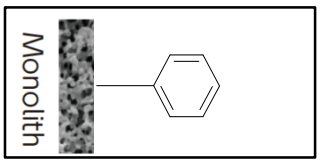
Formats: S L



Bonded with iminodiacetic acid. Optimal for the recovery of trace metals.

MonoSpin Ph

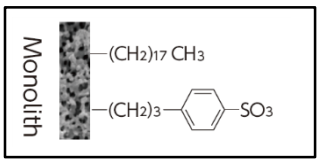
Formats: S



Phenyl functional group. Optimal for the recovery of hydrophobic drugs in biological samples due to its weak retentivity and different selectivity compared to a C18 phase.

MonoSpin C18-CX

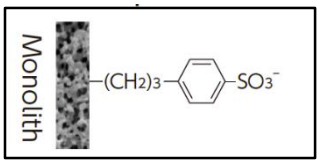
Formats: S



Bonded with octadecyl and benzene sulfonic acid combining both ion exchange & hydrophobic interaction. Optimal for dissociated basic drug in biological samples. Delivers higher cleanup efficiency compared to C18 or SCX.

MonoSpin SCX

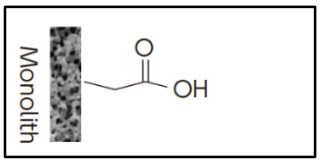
Formats: S L



Bonded with benzenesulfonic acid combining both strong cation exchange & hydrophobic interaction. Optimal for the extraction of basic drugs.

MonoSpin CBA

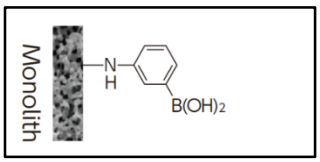
Formats: S L



Bonded with carboxyl acid combining both weak cation exchange. Optimal for the extraction of basic drugs.

MonoSpin PBA

Formats: S



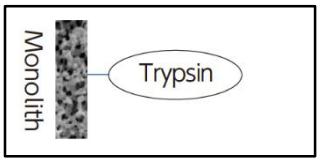
Specific column combined with phenyl boric acid. Excellent for the selective extraction of cis diol compounds, such as catechol amines.

S : Small Type L : Large Type

Product Lineup

MonoSpin Trypsin

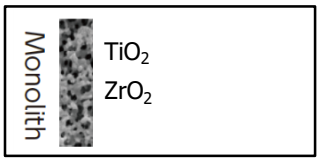
Formats: S



Immobilized trypsin is available for performing rapid and efficient tryptic digests of proteins.

MonoSpin Phospholipid

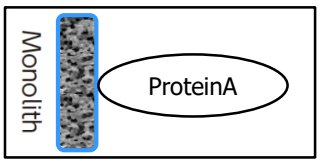
Formats: S L



Monolith skeleton coated with TiO2 and ZrO2. Excellent for the adsorption and removal of phospholipids.

MonoSpin ProA

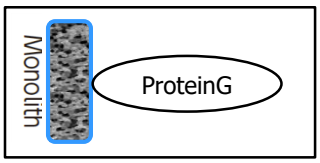
Formats: S 96



Protein A immobilized affinity spin column for the rapid purification of antibodies.

MonoSpin ProG

Formats: S 96



Protein G immobilized affinity spin column for the rapid purification of antibodies.

S: Small Type L: Large Type 96: 96-well plate

Physical Properties

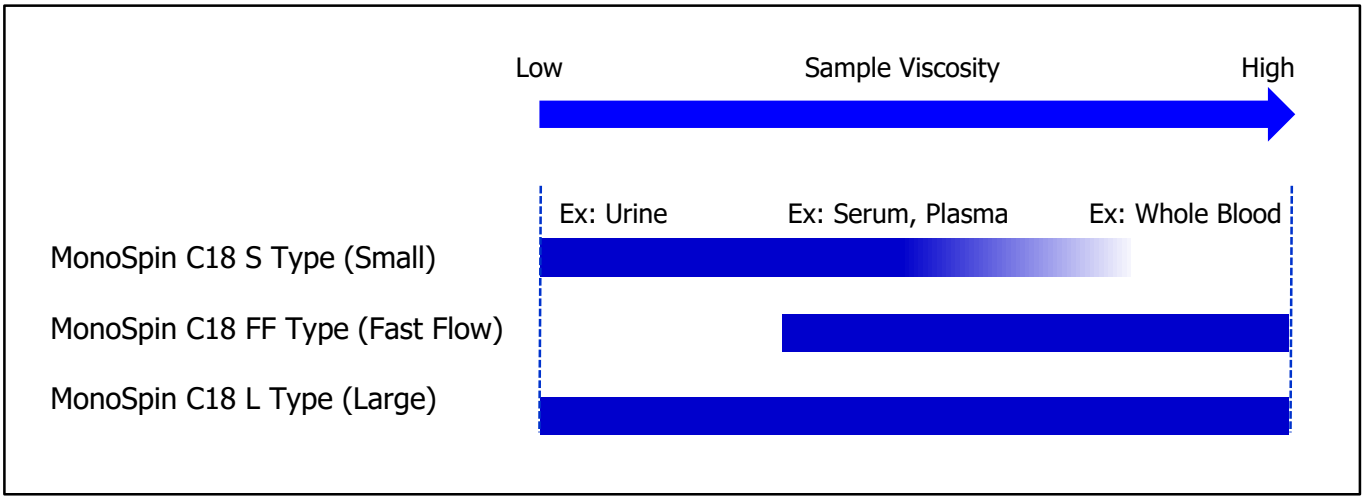
Product	Stationary Phases	S Type (Small)		L Type (Large)		Surface Area (m^2/g)	Sample Loading Capacity (Small Type)	Filter
		Through-pore (µm)	Meso-pore (nm)	Through-pore (µm)	Meso-pore (nm)			
MonoSpin C18	Octadecyl	5	10	10	10	350	100 µg (Amitriptyline)	None
MonoSpin C18 FF	Octadecyl	20	15	-	-	300	50 µg (Amitriptyline)	
MonoSpin Ph	Phenyl	5	10	-	-	350	100 µg (Amitriptyline)	
MonoSpin C18-AX	Octadecyl, Trimethylaminopropyl	5	10	-	-	350	100 µg (Ibuprofen)	
MonoSpin C18-CX	Octadecyl, Benzenesulfonic acid	5	10	-	-	350	100 µg (Amitriptyline)	
MonoSpin SAX	Trimethylaminopropyl	5	10	10	10	350	100 µg (Ibuprofen)	
MonoSpin SCX	Benzenesulfonic acid	5	10	10	10	350	100 µg (Amitriptyline)	
MonoSpin NH2	Aminopropyl	5	10	10	10	350	100 µg (Maltopentaose)	
MonoSpin CBA	Carboxyl	5	10	10	10	350	100 µg (Amitriptyline)	
MonoSpin Amide	Amide	5	10	-	-	350	100 µg (Angiotensin Ⅱ)	
MonoSpin PBA	Phenyl boric acid	5	10	-	-	350	100 µg (Dopamine)	
MonoSpin TiO	Titanium dioxide	20	15	-	-	350	40 µg (Adenosine monophosphate)	
MonoSpin Trypsin	TPCK treated Trypsin	5	10	-	-	350	-	
MonoSpin ME	Iminodiacetic acid	5	10	10	10	350	25 µg (Cu ion)	
MonoSpin Phospholipid	TiO2 + ZrO2	5	10	10	10	350	10 µL (Human serum)	
MonoSpin ProA	Protein A	2	60	-	-	-	400 µg (Human IgG)	
MonoSpin ProG	Protein G	2	60	-	-	-	400 µg (Human IgG)	

Specifications

Description	MonoSpin S Type*1	MonoSpin FF*2	MonoSpin L Type
Disc Size	Φ 4.2 x 1.5 mm	Φ4.2 x 1.5 mm	Φ9 x 3 mm
Sample Volume	50 ～ 800 µL	50 ～ 800 µL	0.5 ～ 8 mL
Elution Volume	50 ～ 800 µL	50 ～ 800 µL	0.5 ～ 8 mL
Centrifugation Speed	2,000～10,000 x *g*	1,000 x *g*	1,000 x *g*
Sample Loading Capacity	100 µg	50 µg	1 mg

Appropriate for Various Viscosity Samples

MonoSpin series are ideal for the sample preparation of biological samples. MonoSpin C18 Fast Flow (FF) type is excellent for high viscosity biological samples. Select the appropriate MonoSpin column type depending on the viscosity of sample and volume.



MonoSpin Applications

The low-pressure, high-flow, and low-liquid-retention properties of GL Sciences' monolith silica technology make it uniquely suited for handling of small samples. MonoSpin SPE centrifugal spin columns have been developed to improve concentration and yields in low-volume sample preparation without requiring evaporation or reconstitution.

Purification and Enrichment of Trace Samples

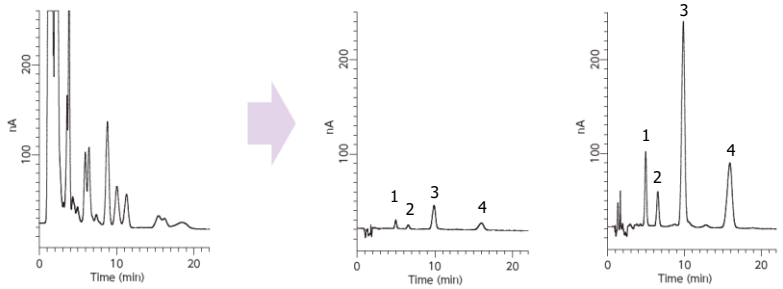
Without MonoSpin PBA

Purification using MonoSpin PBA S Type (Small)

Sample Volume : 500 µL

Elution Volume : 500 µL

Elution Volume : 50 µL
(10-fold concentration)



Conditions

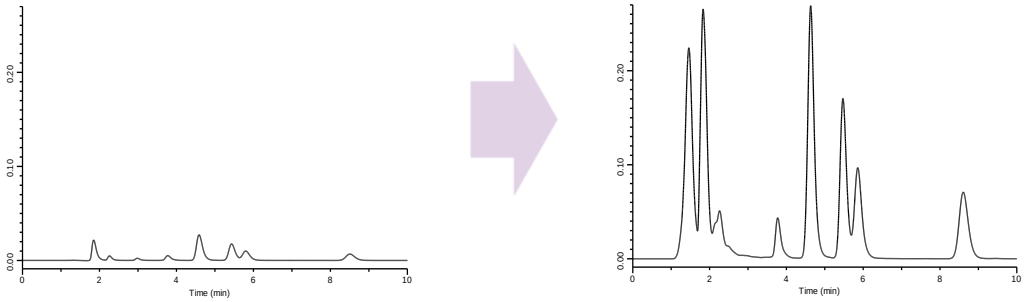
Column	: Inertsil ODS-3 (5 µm, 150 mm × 2.1 mm I.D.)
Eluent	: 50 mM Phosphate buffer (pH 5.6) 50 mg/L EDTA 600 mg/L IPCC-008 -10 % Methanol
Flow Rate	: 0.3 mL/min
Col.Temp.	: 35 ℃
Injection	: 5 µL
Detection	: ECD Pulse Mode
Sample	: 1. Noradrenaline 2. Adrenaline 3. DHBA 4. Dopamine

Without MonoSpin C18

Purification of Serum using MonoSpin C18 L Type (Large)

Sample Volume : 5000 µL

Elution Volume : 500 µL
(10-fold concentration)



5000 µL serum sample is purified with MonoSpin C18 and enriched by 500 µL.

Conditions

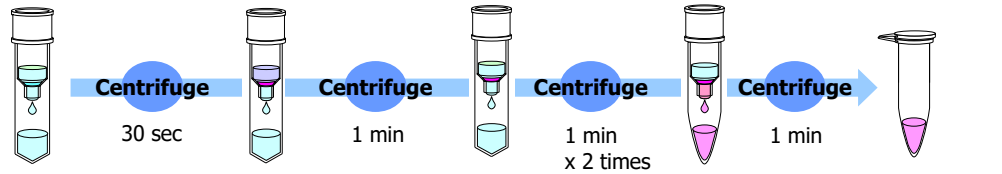
Column	: Inertsil ODS-3（5 µm, 150 × 4.6 mm I.D.）
Eluent	: CH_3CN/3 mM KH_2PO_4, 27 mM SDS=48=52
Flow Rate	: 1.0 mL/min
Col.Temp	: 40 ℃
Injection Vol.	: 1 µL
Detection	: 230 nm

Purification of Amphetamine in Urine using MonoSpin C18

Sample Preparation

800 µL sample solution mixed with 400 µL urine and 400 µL buffer solution (pH 13.0).

Centrifugation
Speed: 5,000 x g



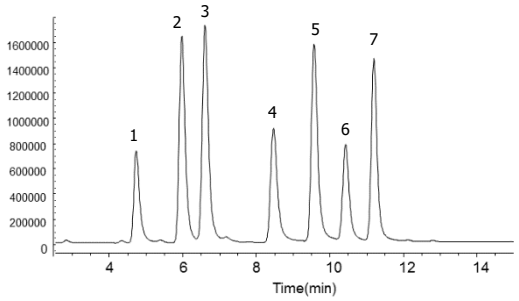
1. Conditioning
Add 100 µL methanol
↓Centrifuge
Add 300 µL buffer
Solution (pH 13.0)

2. Adsorption
Add 800 µL
sample solution

3. Rinsing
Add 300 µL
buffer solution
(pH 13.0)

4. Elution
Add 100 µL
0.1% formic
acid-methanol
(1:1, v/v)

Purified Sample



Conditions

Column	: InertSustainSwift C18 (3 µm, 150× 2.1 mm I.D.)
Eluent	: A)10 mM Ammonium acetate-Formic acid (pH 3.3) B) CH_3OH A/B = 90/10 - 2 min - 90/10 - 13 min - 70/30,v/v
Flow Rate	: 0.3 mL/min
Col. Temp.	: 40 ℃
Detection	: LC/MS
Sample	: 1. Norephedrine 2. Ephedrine 3. Methylephedrine 4. Amphetamine 5. Methamphetamine 6. 3,4-methylenedioxyamphetamine 7. 3,4-methylenedioxymethamphetamine

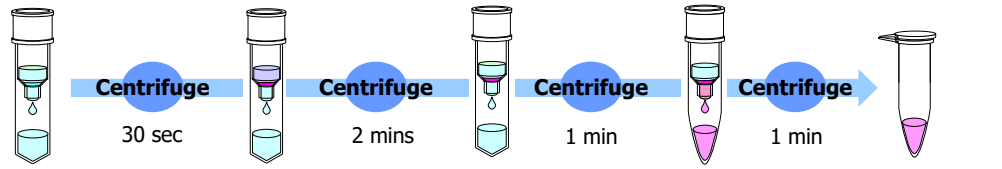
※ Data provided from Hiroshima University, Dr. Namera

Recovery of Drugs in Serum using MonoSpin C18

Sample Preparation

600 µL sample solution mixed with 200 µL serum and 400 µL 10 mM potassium phosphate buffer solution (pH 7.0).

Centrifugation
Speed: 2,300 x g



1. Conditioning
Add 300 µL methanol
↓Centrifuge
Add 300 µL 10 mM
potassium phosphate
(pH 7.0)

2. Adsorption
Add 600 µL
sample solution

3. Rinsing
Add 300 µL
water

4. Elution
Add 200 µL
acetonitrile

Purified Sample

Reproducibility study for drugs in serum sample for three days using MonoSpin C18 (n=10)
MonoSpin demonstrated high reproducibility for purification of drugs.

Sample	Con. (ng/mL)	Rec. (%)	RSD (%)
Desipramine	5	91.2	4.8
	10	86.1	3.3
	50	85.2	5.9
	250	88.4	6.5
Imipramine	5	96.3	9.5
	10	95.8	1.5
	50	94.5	0.9
	250	95.9	0.9
Fluvoxamine	5	96.8	11.6
	10	87.1	5.0
	50	86.8	8.1
	250	87.5	9.7

Sample	Con. (ng/mL)	Rec. (%)	RSD (%)
Paroxetine	5	83.7	3.9
	10	84.1	7.8
	50	83.9	8.2
	250	86.7	7.5
Maprotiline	5	85.7	8.1
	10	84.7	3.2
	50	88.6	5.4
	250	87.5	7.7
Duloxetine	5	106.3	9.9
	10	104.8	6.7
	50	99.8	8.7
	250	99.8	6.0

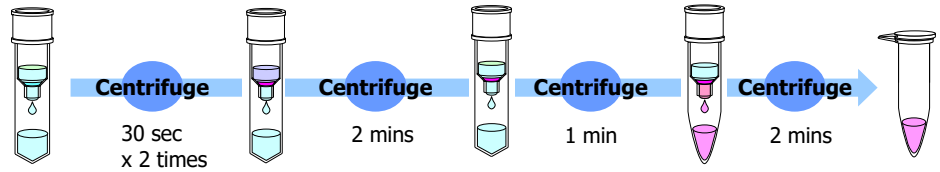
Sample	Con. (ng/mL)	Rec. (%)	RSD (%)
Amitriptyline	5	83.7	7.0
	10	81.8	2.8
	50	83.8	3.0
	250	88.4	2.7
Sulpiride	5	97.9	9.0
	10	95.5	8.5
	50	90.8	2.6
	250	92.6	3.0

Desalting of Protein Digests using MonoSpin C18

Sample Preparation

800 µL sample solution:
Add TFA to tryptic digest sample and adjust the TFA final concentration to 0.1%.

Centrifugation
Speed: 2,300 x g



1. Conditioning
Add 200 µL acetonitrile
↓Centrifuge
Add 200 µL 0.1% TFA aqueous solution

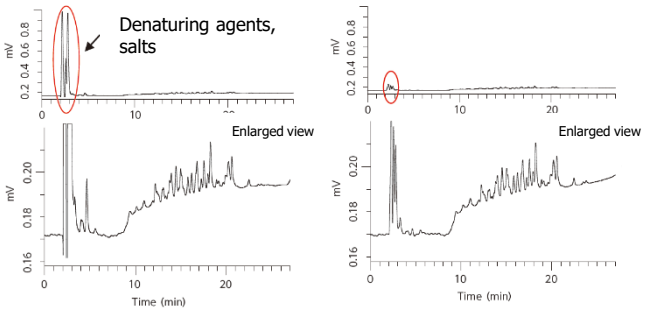
2. Adsorption
Add 800 µL sample solution

3. Rinsing
Add 200 µL 0.1% TFA aqueous solution

4. Elution
Add 200 µL 60% acetonitrile

Desalted Sample

Without MonoSpin C18 | **Desalting using MonoSpin C18**



Conditions

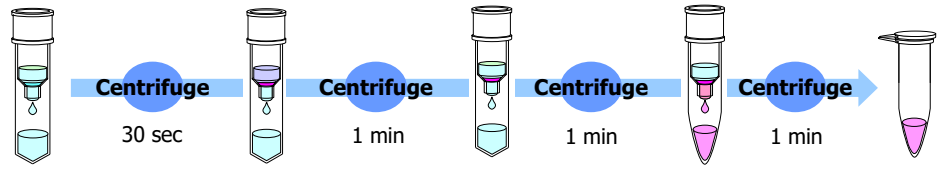
Column	: Inertsil ODS-3 (3 µm, 150× 2.1 mm I.D.)
Eluent	: A) H_2O (0.1 % TFA) B) Acetonitrile (0.1 % TFA) A/B = 90/10 - 20 min - 50/50
Flow Rate	: UV 210 nm
Col. Temp.	: 0.2 mL/min
Detection	: 40 ℃
Sample	: Digested BSA 2 µL

Recovery of Hormone in Serum using MonoSpin C18

Sample Preparation

Add 20 µL of 1 mg/mL of Adrenomedullin to 190 µL of serum. Add 0.1% TFA to the serum solution and centrifuged at 10,000 x g for 1 min. Take the supernatant.

Centrifugation
Speed: 2,300 x g



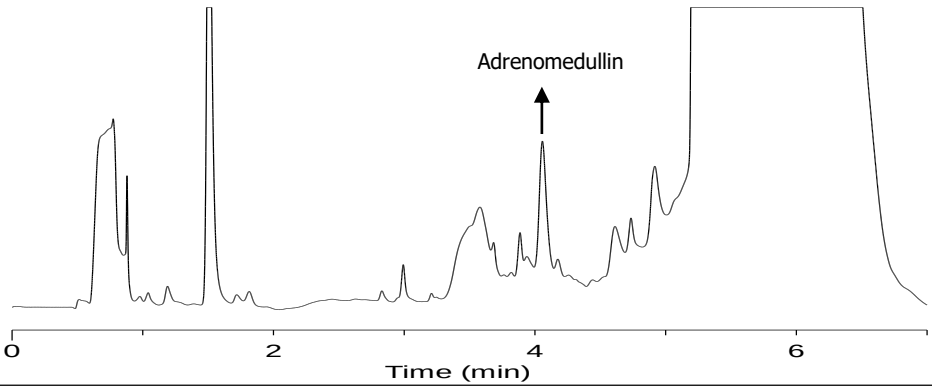
1. Conditioning
Add 200 µL acetonitrile
↓Centrifuge
Add 200 µL 0.1% TFA aqueous solution

2. Adsorption
Add 400 µL sample solution

3. Rinsing
Add 200 µL 0.1% TFA aqueous solution

4. Elution
Add 200 µL 0.1% TFA in 60% acetonitrile

Purified Sample



Conditions

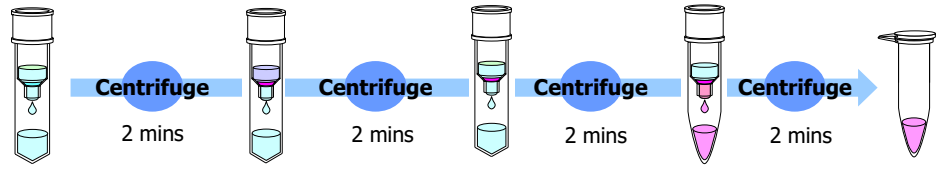
Column	: InertSustain C18 (2 µm, 50 ×2.1 mm I.D.)
Eluent	: A) 0.1 % TFA in H_2O B) 0.1 % TFA in Acetonitrile A/B = 85/15 – 5 min – 50/50 –2 min–50/50
Flow Rate	: 200 µL/min
Col. Temp.	: 40 ℃
Detection	: UV 210 nm
Injection Vol.	: 10µL

Purification of Whole Blood using MonoSpin C18 FF (Fast Flow)

Sample Preparation

Mix 0.3 mL whole blood and 1.2 mL 300 mM phosphate buffer (pH 10). Centrifuge at 12,100 x g for 5 mins and take the supernatant.

Centrifugation
Speed: 1,000 x g



1. Conditioning
Add 300 µL methanol
↓Centrifuge
Add 300 µL 300 mM phosphate buffer (pH 10)

2. Adsorption
Add 1 mL supernatant sample solution

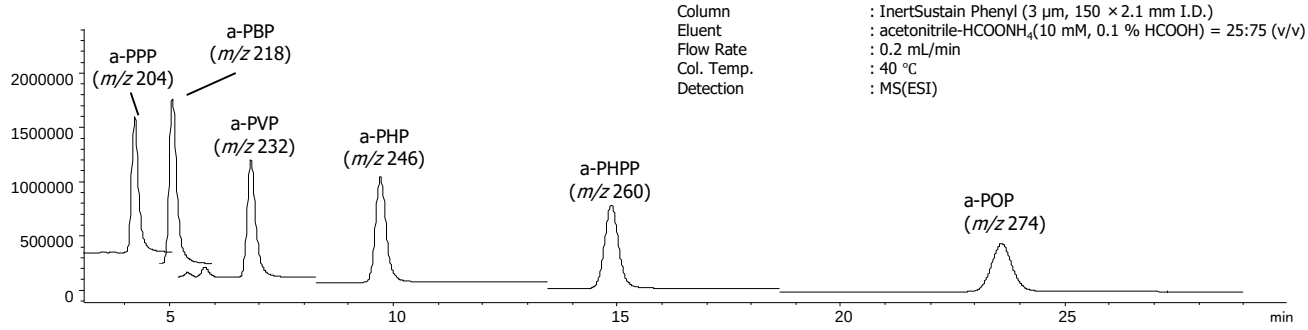
3. Rinsing
Add 300 µL 300 mM phosphate buffer (pH 10)

4. Elution
Add 100 µL methanol

Purified Sample

Conditions

Column	: InertSustain Phenyl (3 µm, 150 ×2.1 mm I.D.)
Eluent	: acetonitrile-$HCOONH_4$(10 mM, 0.1 % HCOOH) = 25:75 (v/v)
Flow Rate	: 0.2 mL/min
Col. Temp.	: 40 ℃
Detection	: MS(ESI)



Features of MonoSpin C18 FF (Fast Flow)

MonoSpin C18 FF is ideal for high viscosity samples, such as whole blood and complex matrix samples.

Specification

Through-pore	20 µm
Meso-pore	15 nm
Disc Size	φ4.2 x 1.5 mm
Sample Volume	50 ～800 µL
Elution Volume	50 ～800 µL
Centrifugation Speed	Under 1,000 x *g*
Sample Loading Capacity	50 µg (Amitriptyline)

MonoSpin C18 FF offer fast flow of viscosity samples at a low centrifugation speed (1,000 x g).
The following is a comparison of flow of solvents between MonoSpin C18 and MonoSpin C18 FF.

Solvents	Volume	MonoSpin C18	MonoSpin C18 FF
Methanol	500 µL	○	○
Water	500 µL	400 µL	○
Serum*	500 µL	300 µL	○

Testing Conditions
1,000 x *g* 30 sec

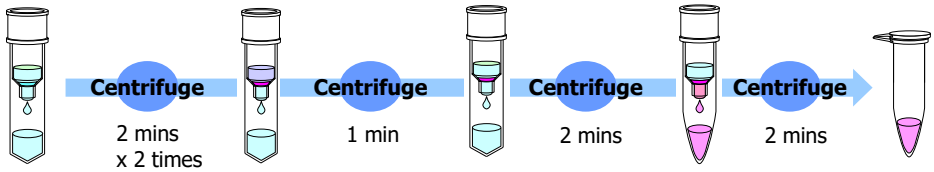
* A supernatant from serum sample was used, which was centrifuged at 10, 000 x g for 1 min.

Purification of Pyridylaminated (PA) Sugar Chain using MonoSpin NH2

Sample Preparation

800 µL sample solution:
Add acetonitrile to PA sugar chain sample solution and adjust the acetonitrile final concentration from 90 to 95%.

Centrifugation
Speed: 2,300 x g



1. Conditioning
Add 500 µL solution mixed with 250 µL 0.1% formic acid* in water and 250 µL 0.1% formic acid in acetonitrile
↓Centrifuge
Add 500 µL solution mixed with 50 µL 0.1% formic acid* in water and 450 µL 0.1% formic acid in acetonitrile

2. Adsorption
Add 800 µL sample solution

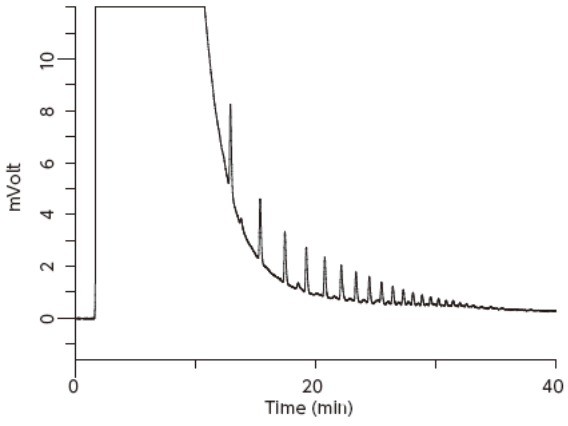
3. Rinsing
Add 500 µL solution mixed with 50 µL 0.1% formic acid* in water and 450 µL 0.1% formic acid in acetonitrile

4. Elution
Add 50-800 µL 0.1% formic acid in 50% acetonitrile

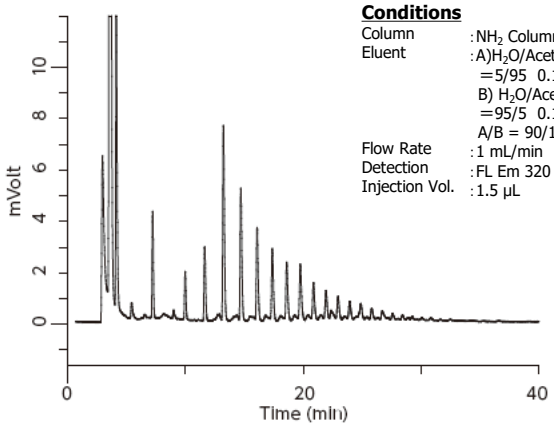
Purified Sample

* Acetic acid or TFA can also be used as an alternative to formic acid.

Without MonoSpin NH2



Purification of PA using MonoSpin NH2



Conditions

Column	: NH_2 Column (5 µm, 250× 4.6 mm I.D.)
Eluent	: A) H_2O/Acetonitrile =5/95 0.1 % Formic acid B) H_2O/Acetonitrile =95/5 0.1 % Formic acid A/B = 90/10-10 min–90/10-40 min-60/40
Flow Rate	: 1 mL/min
Detection	: FL Em 320 nm, Ex 400 nm
Injection Vol.	: 1.5 µL

Purified PA sugar chain by HILIC mode.
MonoSpin NH2 additionally removes residual fluorescent labeling reagents.

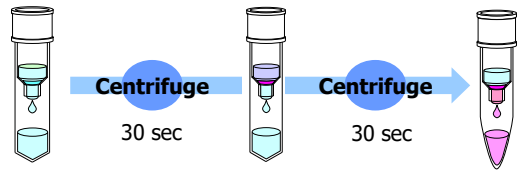
Fractionation of Protein Digests using MonoSpin SCX

MonoSpin SCX provide a rapid and easy fractionation of peptides by stepwise elution using buffers with various salt concentration.

Sample Preparation

500 µL sample solution: First, desalt the peptide solution using MonoSpin C18. Then, dissolve the desalted sample solution with 0.1% formic acd.

Centrifugation
Speed: 10,000 x g

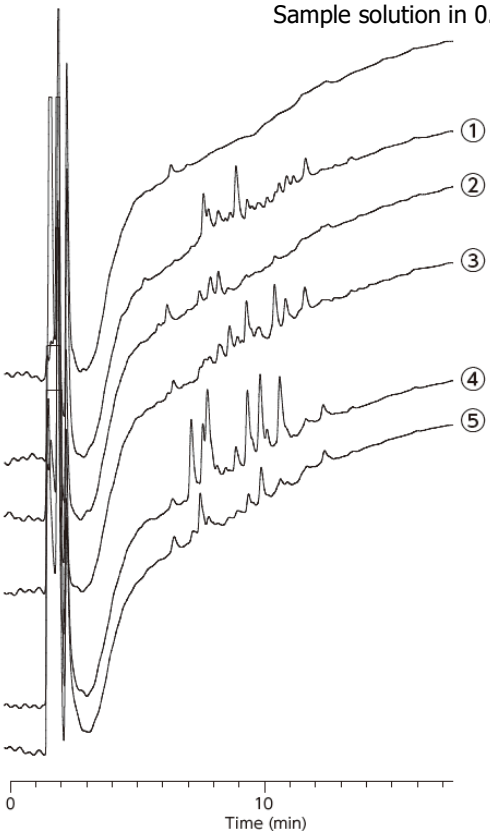


1. Conditioning
Add 300 µL 0.1% formic acid

2. Adsorption
Add 500 µL peptide sample solution

3. Elution

Sample solution in 0.1% formic acid



Always replace and attach a new recovery tube whenever adding a new elution buffer

Details of each elution buffer

①25 mM $HCOONH_4$	200 µL
②50 mM $HCOONH_4$	200 µL
③100 mM $HCOONH_4$	200 µL
④500 mM $HCOONH_4$	200 µL
⑤1 M $HCOONH_4$	200 µL

* Each elution buffer contains 10% acetonitrile

Conditions

Column : Inertsil ODS-3 (3 µm, 2.1 × 150 mm)
Eluent : A)H_2O (0.1 % HCOOH)
B)Acetonitrile (0.1 % HCOOH)
A/B = 90/10 - 20 min - 50/50

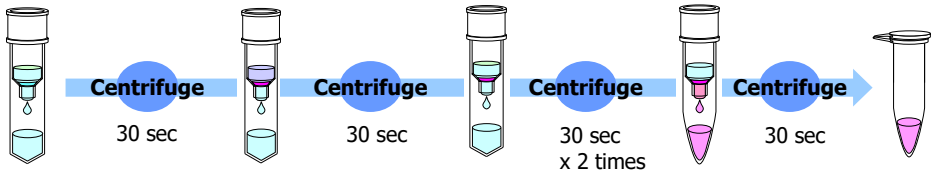
Detection : UV 210 nm
Flow Rate : 0.2 mL/min
Col. Temp. : 40 °C
Injection Vol. : 2 µL

Purification of Paraquat and Diquat using MonoSpin CBA

Sample Preparation

600 µL sample solution:
Add 200 µL urine and and 400 µL 10 mM potassium phosphate buffer (pH 7.0)

Centrifugation
Speed: 10,000 x g



1. Conditioning
Add 200 µL 10 mM potassium phosphate buffer (pH 7.0)

2. Adsorption
Add 600 µL sample solution

3. Rinsing
Add 200 µL 10 mM potassium phosphate buffer (pH 7.0)

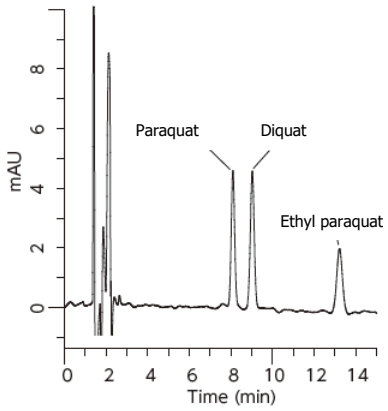
4. Elution
Add 200 µL solution mixed 1% HCL, 30% methanol and 69% water

Purified Sample

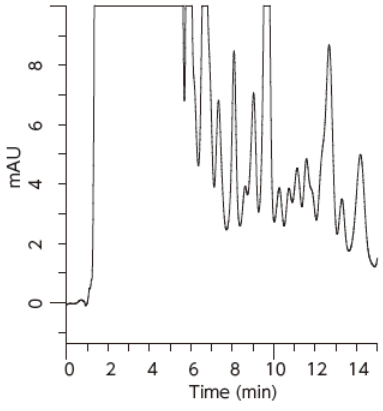
Conditions

Column	: Inertsil ODS-3 (5 µm,
Eluent	150 mm × 4.6 mm I.D.)
	: 0.2 M phosphoric acid, 0.1 M diethyl amine, 7.5 mM IPCC08(IPCC-0.8, Sodium 1-Octanesulfonate) /Acetonitrile=89/11
Flow Rate	: 1 mL/min
Col.Temp.	: 40 ℃
Detection	: PDA 290 nm
Injection Vol.	: 50 µL

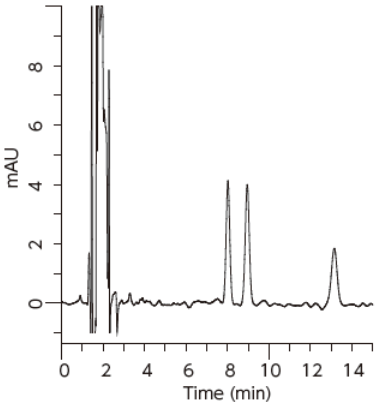
Standard Solution (1 µg/mL)



Urine + Pesticide (1 µg/mL)



Purification using MonoSpin CBA



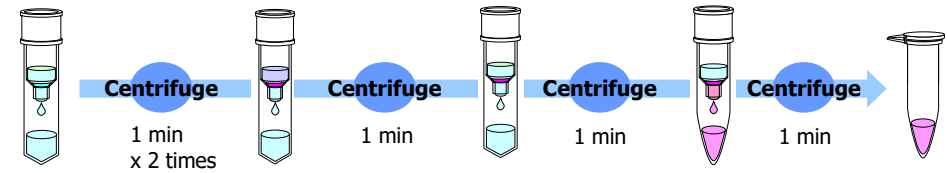
MonoSpin CBA deliver highly efficient purification of strong basic pesticides such as Paraquat and Diquat.

Purification of Catecholamines using MonoSpin PBA

Sample Preparation

250 µL sample solution:
Add 200 µL urine or serum and 50 µL 1 M potassium phosphate buffer (pH 8.0 adjust using phosphoric acid)

Centrifugation
Speed: 10,000 x g



1. Conditioning
Add 200 µL 1% acetic acid
↓Centrifuge
Add 200 µL 100 mM potassium phosphate buffer (pH 8.0)

2. Adsorption
Add 250 µL sample solution

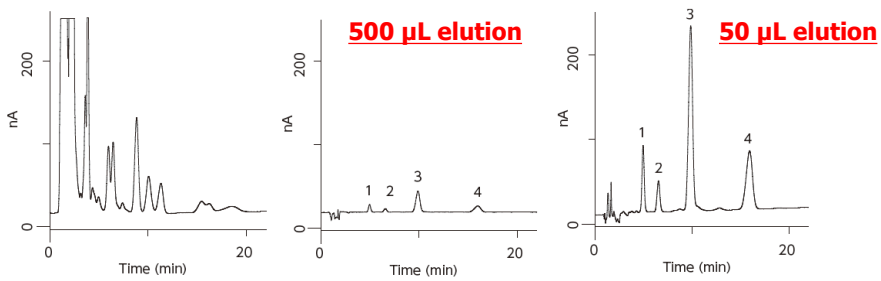
3. Rinsing
Add 200 µL 100 mM potassium phosphate buffer (pH 8.0)

4. Elution
Add 200 µL 1% acetic acid

Purified Sample

Without MonoSpin PBA

Purification using MonoSpin PBA



Conditions

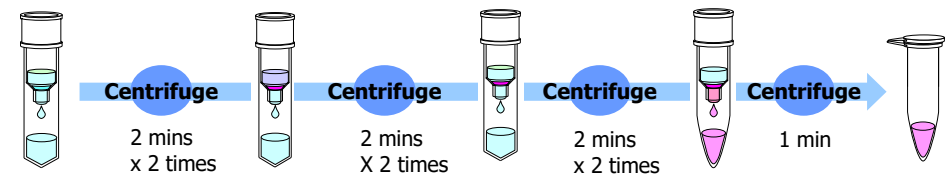
Column	:Inertsil ODS-3 (5 µm, 150 mm × 2.1 mm I.D.)
Eluent	:50 mM Phosphate buffer (pH 5.6) 50 mg/L EDTA 600 mg/L IPCC-008 -10 % Methanol
Flow Rate	:0.3 mL/min
Col.Temp.	:35 ℃
Injection	:5 µL
Detection	:ECD Pulse Mode
Sample	:1. Noradrenaline 2. Adrenaline 3. DHBA 4. Dopamine

Purification of Organic Phosphorous Pesticides in Serum using MonoSpin TiO

Sample Preparation

50 µL sample solution:
Add 10 µL serum sample and 40 µL water

Centrifugation
Speed: 5,200 x g



1. Conditioning
Add 20 µL 0.1% TFA in 80% acetonitrile
↓Centrifuge
Add 20 µL 0.1% TFA in 50% acetonitrile

2. Adsorption
Add 50 µL sample solution
↓Centrifuge
Collect the eluate from the recovery tube & attach a new recovery tube. Then, applythe eluate to MonoSpin TiO again.

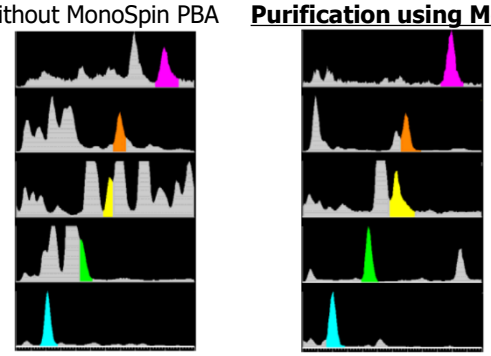
3. Rinsing
Add 20 µL 0.1% TFA in 50% acetonitrile
↓Centrifuge
Add 20 µL 0.1% TFA in 50% acetonitrile

4. Elution
Add 50 µL 2% ammonia aqueous solution

Purified Sample
Derivatize the purified sample with N-Acetyl-O-methyl and then inject to LC/MS

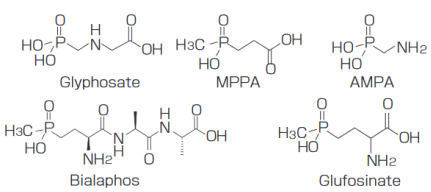
Without MonoSpin PBA

Purification using MonoSpin TiO



Conditions

Column	:ODS (150 mm × 2.1 mm I.D.)
	:CH3OH/20 mM HCO2NH4
Eluent	(pH 3.0) = 15/85
Flow Rate	:200 µL/min
Injection	:5 µL
Detection	:SIM
Sample	:1. Bialaphos 2. Glyphosate 3. MPPA 4. Glufosinate 5. AMPA (1 ppm each)



Rapid Digestion of BSA using MonoSpin Trypsin

Example of Reduction and Alkylation Protocol

1 mg Bovine serum albumin

----- Add 175 µL 500 mM Tris-HCL (pH 8.0) and 8 M urea (Solution 1).
----- Add 25 µL 40 mg/mL dithiothreitol in Solution 1.
----- Incubation at 37 ℃ for 90 mins

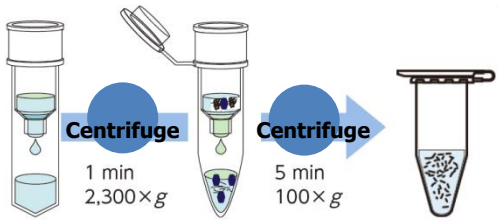
----- Add 50 µL 40 mg/mL iodoacetoamide in Solution 1.
----- Incubation at 37 ℃ for 30 mins without exposure to light.

250 µL Reduced and alkylated protein

----- Add 50 mM ammonium bicarbonate to make the urea final concentration to 2 M and dilute it to 750 µL

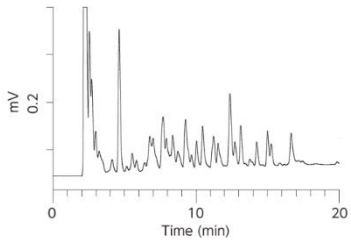
MonoSpin Trypsin

The protocol above is just an example.
Optimize the protocol of preparation of reduced and Alkylated sample depending on the types of proteins.

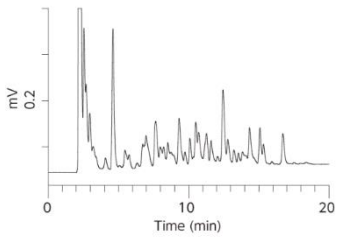


Conditioning Digestion

Incubation at 37 ℃ for 10 hours



Protein Digestion at 25 ℃ for 10 minutes using MonoSpin Trypsin



Conditions

Column	: Inertsil ODS-3 (3 µm, 150× 2.1 mm I.D.)
Eluent	: A) H_2O (0.1 % HCOOH) B) Acetonitrile (0.1 % HCOOH) A/B = 90/10 - 20 min - 50/50
Flow Rate	: UV 210 nm
Col. Temp.	: 0.2 mL/min
Detection	: 40 ℃
Sample	: Digested BSA 2 µL

MonoSpin Trypsin provide rapid and efficient protein digestion at room temperature in 10 mins.

List of References

Products	Target Analytes	Sample Matrix	Concentration	Recovery Rate	Detection	Reference No.
MonoSpin® C18	amitraz, metabolites	serum	5 ng/mL	95.5, 92.2 %	LC-MS	[1]
	dibudcaine, naphazoline	serum	5 - 10 ng/mL	70.2 - 78.6 %	LC-MS	[2]
	MA, AP, MDA, MDMA	urine	100 ng/mL	96 - 111 %	LC-UV	[3]
	9 cold medicines	serum	5 - 50 ng/mL	2.5 - 73.8 %	GC-MS	[4]
	amphetamines (AP, MA, MDA, MDMA)	urine	5 - 10 ng/mL	84 - 94 %	GC-MS	[5]
	eperison	serum	0.5 ng/mL	92.8 - 96.0 %	GC-MS	[6]
	paraquat, diquat, fenitrothion	serum, urine	25 - 100 ng/mL	51.3 - 106.1 %	GC-MS	[7]
	arsenics	urine	1 ng/mL	91.9 - 106.5 %	GC-MS	[8]
	MAM-2201	blood	1 ng/mL	-	LC-MS/MS	[9]
	a-PVP, a-PBP	urine	1 ng/mL	82 - 100 %	GC-MS	[10]
	a-PVP, a-PBP	hair	0.2 ng/mL	75.5 - 101.5 %	LC-MS	[11]
	Phthalic acid esters	physiological saline	0.2 - 50 µg/L	71.2 - 107.3 %	-	[12]
	＜desalting＞	digested peptides	-	-	-	[13]
	＜desalting＞	iTRAQ labeled samples	-	-	-	[14]
	MAM-2201	blood	2.5 - 100 ng/mL	1 ng/mL	-	[15]
	Naringin	grapefruit juice	10 - 500 µM	10 µM	-	[16]
MonoSpin® SCX	opiates benzodiazepines, metabolites	urine serum	10 ng/mL 1 - 10 ng/mL	69.2 - 98.9 % 83.3 - 112.3 %	LC-MS	[17]
	＜Pre-column fluorescence derivatization＞	-	-	-	-	[18]
	＜desalting of amino acid＞	-	-	-	-	[19]
MonoSpin® C18-CX	acidic and basic drugs	urine	1 - 25 ng/mL	65 - 123 %	GC-MS	[20]
	＜halogenated compounds＞	cells	-	-	-	[21]
MonoSpin® C18-AX	amphetamines (AP, MA), opiates, THC	urine	2 - 10 ng/mL	93.1 - 108.1 %	GC-MS	[22]
MonoSpin® PBA	Adenosine	urine	6 µM	80 - 113 %	-	[23]

[1] J. Chromatogr., B 867 (2008) 99-104.
[2] J. Chromatogr., B 872 (2008) 186-190.
[3] J. Chromatogr., A 1208 (2008) 71-75.
[4] Chromatographia., 70 (2009) 519-526.
[5] Anal. Chim. Acta., 661 (2010) 42-46.
[6] J. Health Sci., 56 (2010) 598-605.
[7] Anal. Bioanal. Chem., 400 (2011) 25-31.
[8] J. Sep. Sci., 35 (2012) 2506-2513.
[9] Forensic Toxicol., 31 (2013) 333-337.
[10] Forensic Toxicol., 32 (2014) 68-74
[11] J. Chromatogr., B 942-943 (2013) 15-20.
[12] J Pharm Anal., 1 (2011) 92-99
[13] Proteomics., 13 (2013) 751-755
[14] Journal of proteomics., 84 (2013) 40-51
[15] Forensic Toxicol., 31 (2013) 333-337
[16] The Journal of Clinical Pharmacology., 54 (2013)
[17] J. AOAC Int., 94 (2011) 765-774.
[18] Biomed. Chromatogr., 26 (2012) 147-151.
[19] Orig Life Evol Bjosph., 43 (2013) 99-108
[20] J. Sep. Sci., 34 (2011) 2232-2239.
[21] Toxicology., 314 (2013) 22-29
[22] Forensic Toxicol., 31 (2013) 312-321.
[23] Biosensors and Bioelectronics., 41 (2013) 379-385

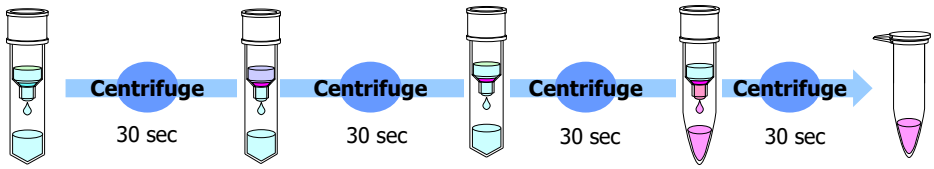
Recovery of Metal Ions using MonoSpin ME

MonoSpin ME is bonded with iminodiacetic acid and optimal for the recovery and purification of metal ions. Specifically, it is excellent for the extraction and purification of trace Pb in blood or urine. Additionally, it is appropriate for removing inorganic divalent cations from sample to prevent ion suppression for LC-MS/MS applications.

Sample Preparation

500 µL 25 µg/mL Cu^{2+}

Centrifugation
Speed: 3,000 x g



1. Conditioning
Add 200 µL water
↓Centrifuge
Add 200 µL 2N-HNO_3
↓Centrifuge
Add 400 µL
100 mM CH_3COONH_4
(pH 5.5)

2. Adsorption
Add 500 µL
25 µg/mL Cu^{2+}

3. Rinsing
Add 100 mM
CH_3COONH_4
(pH 5.5)

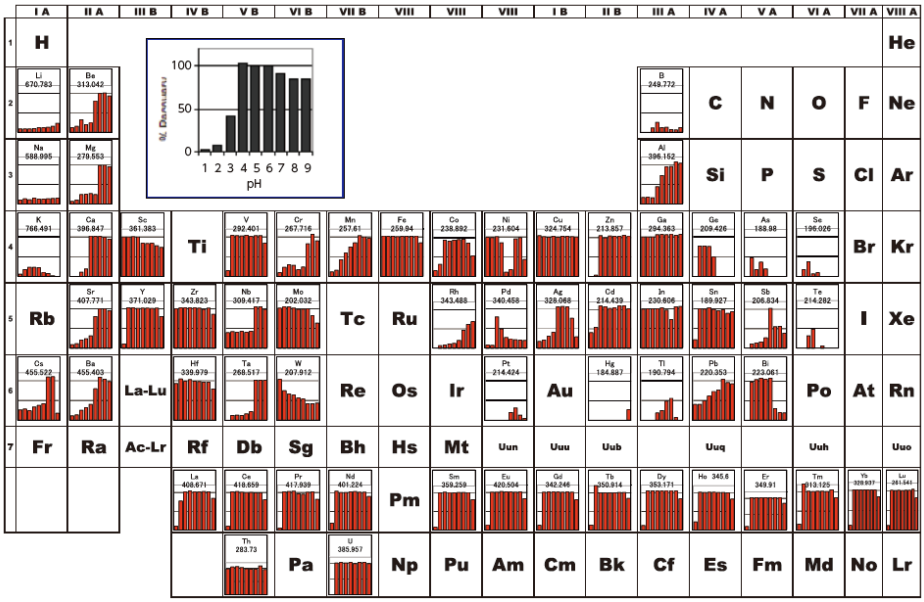
4. Elution
Add 500 µL
2N-HNO_3

Purified Sample

Recovery rate of Cu^{2+} using Zeeman GF-A-AF system

Number of Injections	Volume of solvent introduced (mL)	Recovery rate (%)
1	0.8	98±4
2	1.6	97±5
3	2.4	95±5
4	3.2	95±5
5	4	94±3

Retention Characteristics of Metal Element using Iminodiacetic Acid Functional Groups with Various pH



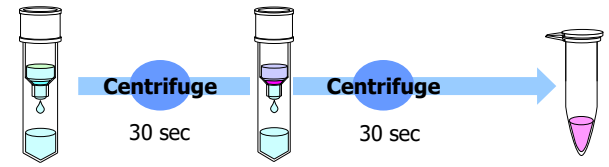
Removal of Phospholipids using MonoSpin Phospholipid

MonoSpin Phospholipid removes more than 90% of phospholipids from biological samples resulting in eliminating ion suppression in LC-MS/MS analysis. The MonoSpin Phospholipid also removes phospholipids from a serum sample volume of 50 µL.

Sample Preparation

Mix 0.1% formic acid in acetonitrile with serum (4:1) in 2 mL tube. Centrifuge at 10,000 x g for 30 sec. Take the supernatant.

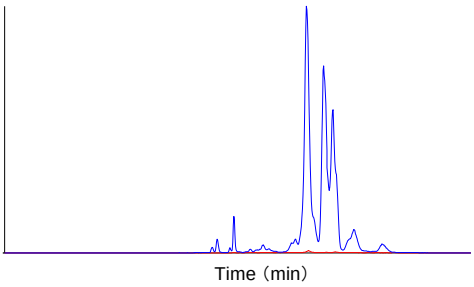
Centrifugation
Speed: 3,000 x g



1. Conditioning
Add 200 µL 0.1% formic acid in acetonitrile
↓Centrifuge
Add 200 µL 2N-HNO_3
↓Centrifuge
Add 400 µL
100 mM CH_3COONH_4
(pH 5.5)

2. Adsorption
Add 500 µL
sample solution

Phospholipid-free sample



Deproteinized and centrifuged supernatant

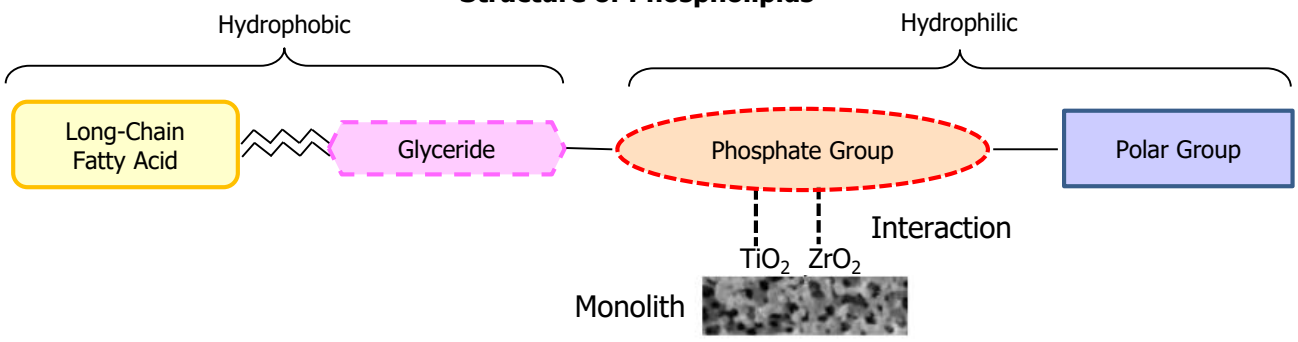
Sample clean up by MonoSpin Phospholipid
(Removes more than 90% of phospholipids)

Phospholipid Removal Efficiency of MonoSpin Phospholipid

Retention Mechanism of Phospholipids

Monolith skeletal structure coated with TiO_2 and ZrO_2 selectively interacts with metal oxides and phosphorylated compounds, resulting in removing more than 90 % of phospholipids.

Structure of Phospholipids

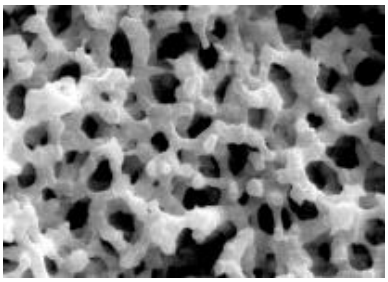


Rapid Purification of Antibodies using MonoSpin ProA and ProG

MonoSpin ProA and MonoSpin ProG are immobilized with protein A or protein G onto a silica monolith offering rapid purification of antibodies. A 96-well plate format is also available for high throughput purification.

Features

The silica is modified with a hydrophilic polymer and then immobilized with either Protein A or Protein G to prevent the adsorption of proteins, resulting in rapid purification and high recovery of antibodies.

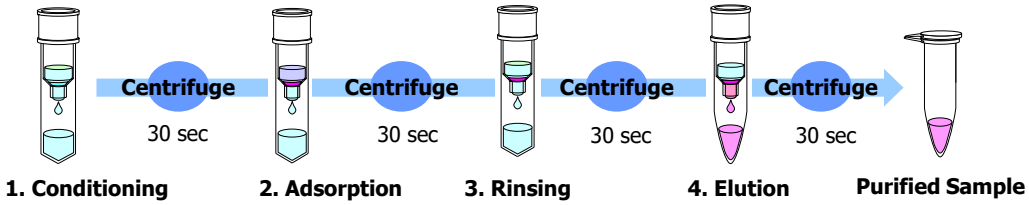


Specification	
Bonded Phase	Protein A or Protein G
Through-pore	2 μm
Meso-pore Size	60 nm
Disc Size	Φ4.6 x 1.5 mm
Sample Volume	50 - 500 μL
Recovery Rate	MonoSpin ProA：IgG 90 %（With 400 mg IgG）
	MonoSpin ProG：IgG 90 %（With 300 mg IgG）
Elution Volume	50 μL
Centrifugation speed	2,300 × *g*

Antibody Compatibility Table

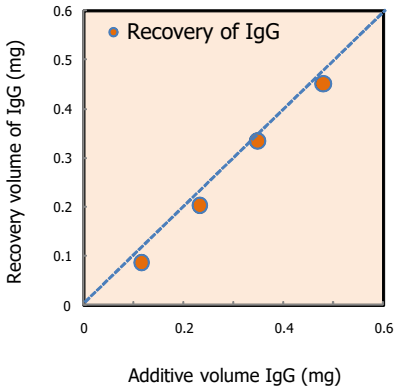
Species	Antibody Class	Protein A	Protein G
Human	IgG	◎	◎
	IgG1	◎	◎
	IgG2	◎	◎
	IgG3	—	◎
	IgG4	◎	◎
	IgM	—	—
	IgA	—	—
	IgE	—	—
	IgD	—	—
	Fab	○	○
	ScFv	○	—

Purification of IgG only in Five Minutes using MonoSpin ProA and ProG

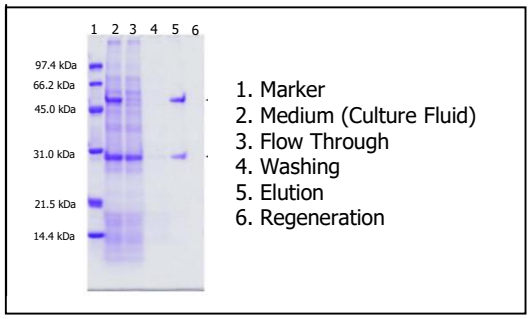


As shown below, the antibody concentrations were determined quantitatively from medium of CHO cells. The purified antibodies show very less impurities by the results from electrophoresis.

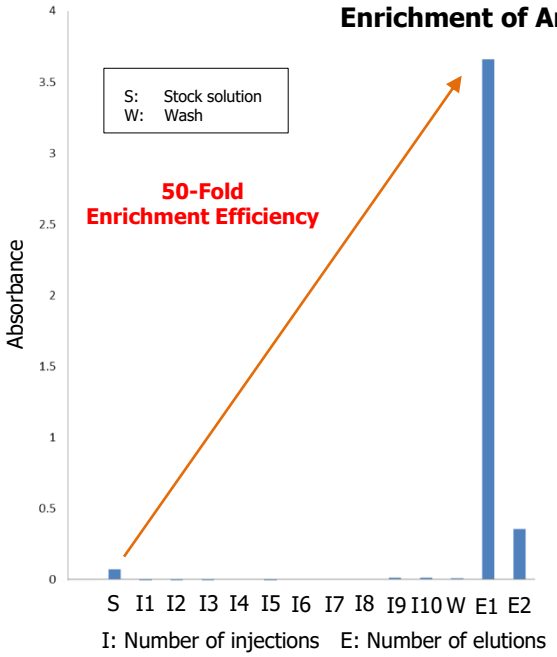
Calibration Curve of IgG Concentration



Results of Recovery by Electrophoresis



Enrichment of Antibody Solution using MonoSpin ProA



500 µL volume of 0.025 mg / mL of human IgG solution was applied to MonoSpin ProA spin column (ten consecutive times).
Then, the elution of IgG concentration was measured with 100 µL elution buffer twice (E1 and E2). The first IgG elution (E1) was 50-fold concentration of the stock solution and showed 90 % recovery of IgG without the loss of IgG.

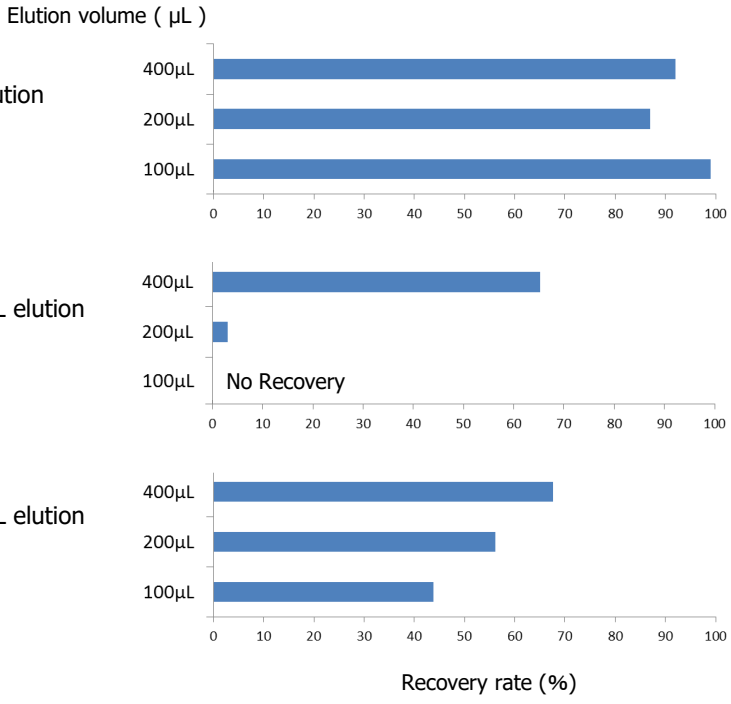
Comparison of Elution Volume & Recovery Rate with other Brands' Products

MonoSpin ProA only requires 100 µL elution buffer, providing a recovery rate of at least 90% IgG. On the other hand, other brands' products requires 400 µL of elution buffer with a recovery rate of 70% IgG.

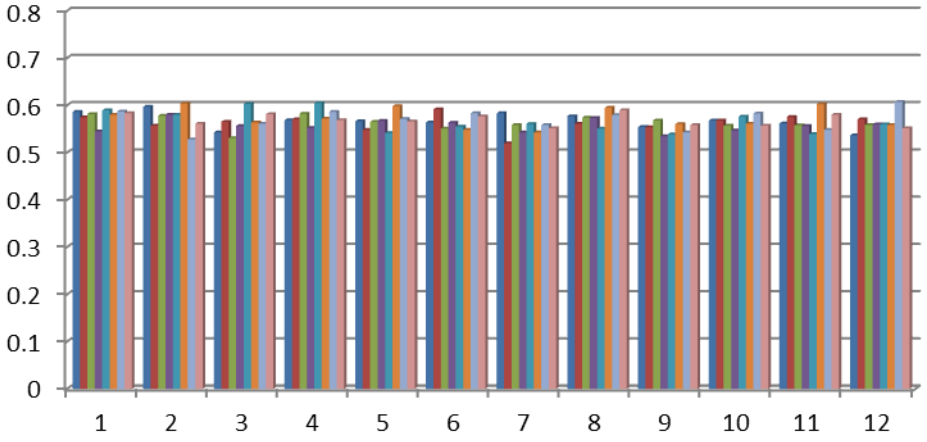
MonoSpin ProA
90 % recovery rate of IgG with 100 µL elution

Brand T's Product
60-65 % recovery rate of IgG with 400 µL elution

Brand G's Product
65-70 % recovery rate of IgG with 400 µL elution



Recovery Rate and Reproducibility of IgG from medium cultured CHO cells with MonoSpin ProA 96-Well Plate



Sample volume:	150 mL
Elution volume:	150 mL
Recovery rate:	90 % (CV 3.1 %)
IgG concentration:	1.3 mg/mL

Ordering Information

MonoSpin S Type (Small) Columns

- Each MonoSpin S Type (Small) columns are attached with 1.7 mL recovery tubes and 2.0 mL waste tubes.

Description	Qty	Cat. No.
MonoSpin C18	50 pcs	5010-21700
	100 pcs	5010-21701
MonoSpin C18 FF	50 pcs	5010-21670
	100 pcs	5010-21671
MonoSpin Ph	50 pcs	5010-21733
	100 pcs	5010-21734
MonoSpin C18-AX	50 pcs	5010-21735
	100 pcs	5010-21736
MonoSpin C18-CX	50 pcs	5010-21731
	100 pcs	5010-21732
MonoSpin SAX	50 pcs	5010-21720
	100 pcs	5010-21721
MonoSpin SCX	50 pcs	5010-21725
	100 pcs	5010-21726
MonoSpin NH2	50 pcs	5010-21710
	100 pcs	5010-21711
MonoSpin CBA	50 pcs	5010-21729
	100 pcs	5010-21730
MonoSpin Amide	50 pcs	5010-21727
	100 pcs	5010-21728
MonoSpin PBA	50 pcs	5010-21715
	100 pcs	5010-21716
MonoSpin TiO	50 pcs	5010-21705
	100 pcs	5010-21706
+ MonoSpin Trypsin	50 pcs	7820-11300
	100 pcs	7820-11301
MonoSpin ME	50 pcs	5010-21737
	100 pcs	5010-21738
MonoSpin Phospholipid	50 pcs	5010-21698
	100 pcs	5010-21699

* MonoSpin Trypsin must be refrigerated when not in use.

MonoSpin S Type (Small)

Recovery Tube
(1.7 mL)

Waste Tube
(2 mL)

Ordering Information

MonoSpin L Type (Large) Columns

Description	Qty	Cat. No.
MonoSpin L C18	30 pcs	7510-11320
MonoSpin L SAX	30 pcs	7510-11321
MonoSpin L SCX	30 pcs	7510-11322
MonoSpin L NH2	30 pcs	7510-11323
MonoSpin L CBA	30 pcs	7510-11324
MonoSpin L ME	30 pcs	7510-11325
MonoSpin L Phospholipid	30 pcs	7510-11326

MonoSpin L Type (Large)

* Each MonoSpin L Type (Large) columns does not come with any recovery and waste tubes.
* Please prepare a 50 mL centrifuge tube separately (Ex: Falcon tube).

MonoSpin ProA, MonoSpin ProG

Description	Qty	Cat. No.
MonoSpin ProA	10 pcs	7510-11310
MonoSpin ProG	10 pcs	7510-11311
MonoSpin ProA 96-Well Plate	1/pk	7510-11312
MonoSpin ProG 96-Well Plate	1/pk	7510-11313

* MonoSpin ProA, ProG must be refrigerated when not in use.

MonoSpin S Type (Small) Trial Kits

- The following trial kits are available for purchase to test a whole range of MonoSpin columns to make the best decision on which MonoSpin to use.

Description	Available Phases	Qty	Cat. No.
MonoSpin Trial Kit 1	C18, TiO, SCX, SAX, 10 pcs each.	10 pcs/4 pk	5010-21740
MonoSpin Trial Kit 2	C18, Amide ,CBA, NH2, 10 pcs each.	10 pcs/4 pk	5010-21741
MonoSpin Trial Kit 3	SCX, SAX, CBA, NH2, 10 pcs each.	10 pcs/4 pk	5010-21742

- MonoSpin Trial Kit 1: Optimal for drug extraction in biological samples & purification of pesticides.
- Monospin Trial Kit 2: Compatible with both hydrophilic/hydrophobic applications. Optimal for purification of peptide and sugar chains.
- MonoSpin Trial Kit 3: Optimal for purification of ionic analytes.

Based on monolithic technology, Merck KGaA, Darmstadt, Germany.

FastRemover for Protein

Maximizes Sample Yield

FastRemover is a 96-well type filter plate ideal for preparing precipitated protein samples. High-throughput processing of plasma samples is performed simply, accurately, and reproducibly.

Features

- Easy filtration of biological samples.
- Trace analytes can be processed with minimal sample loss owing to the low volume design of the elution tip and filter.
- Perfect for processing with automated vacuum instruments.
- High sensitivity analysis is unaffected by contamination from plasticizers or other impurities found in other 96-well plates.
- Removal of microparticle contaminants enables injection to LC/MS/MS directly from the collection plate.

Typical Protocol using FastRemover for Protein

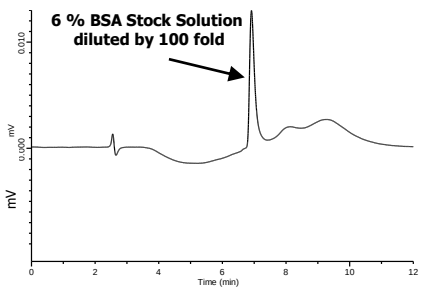
To demonstrate the performance of FastRemover for Protein, a BSA solution was prepared as follows:

Performance of Removal of Proteins

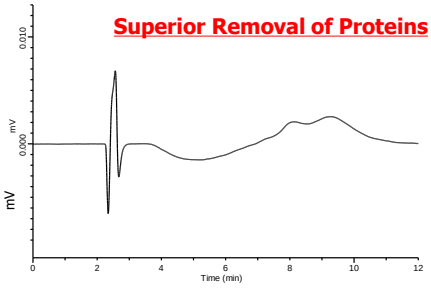
1. 200 uL of plasma is thoroughly mixed in a test tube containing 800uL of acetonitrile.
2. The FastRemover and collection plate are attached to a vacuum manifold.
3. The BSA sample mixture is loaded into the 96-well plate and vacuum applied above 0.02 Mpa (0.2 Bar) for 2 minutes.

* Methanol can be used as well as a replacement of acetonitrile.

[Standard Sample]



[After filtrated with FastRemover]



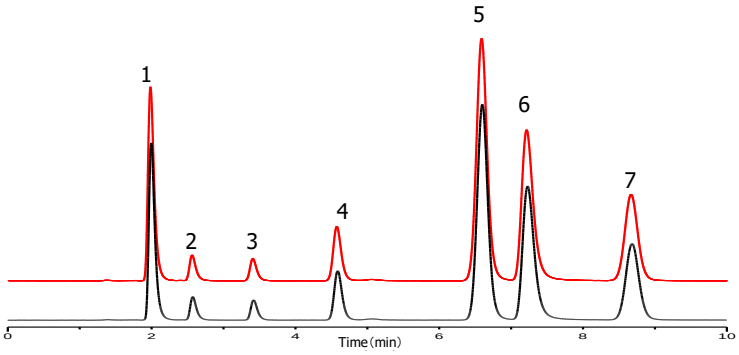
Conditions

Column	:Inertsil WP300 C8 (5 um, 150 x 2.1 mm I.D.)
Eluent:	:A) 0.1% TFA in CH_3CN B) 0.1 % TFA in H_2O A/B=10/90 – 5 min - 50/50
Flow Rate	:0.2 mL/min
Col.Temp.	:40 C
Detection	:280 nm
Injection Vol.	:2 uL

Adsorption Test

A standard mixture containing 7 compounds were analyzed to evaluate potential non-specific adsorption to the plate. As shown in the following chromatograms, FastRemover for Protein provides minimal loss of target samples.

Black: **Before treatment with FastRemover**
Red: **After treatment with FastRemover**



Excellent Non-Specific Adsorption to the Plate

Conditions

Column	:Inertsil ODS-3 (3 um, 150 x 2.1 mm I.D.)
Eluent:	:48% CH_3CN (0.7 % KH_2PO_4 + 0.17% SDS, pH 4.5)
Flow Rate	:0.2 mL/min
Col.Temp.	:40 C
Detection	:230 nm
Injection Vol.	:1 uL
Samples	1. Acetaminophen 2. Pyridine 3. Phenol 4. Hexobarbital 5. Propranolol 6. Berberine 7. Doxepin

Ordering Information

FastRemover for Protein

Description		Qty	Cat. No.
FastRemover for Protein (0.45 µm)	96-well	1/pk	7820-11001
		5/pk	7820-11005
FastRemover for Protein (0.20 µm)	96-well	1/pk	7820-11011
		5/pk	7820-11015

Related Accessories

Description	Qty	Cat. No.
Vacuum Manifold with shims	1 Set	5010-33101
Sealing Mat for Microplate, WSM-3SX (PTFE/SILCON)	5/pk	1030-43831
Sealing Tape for Microplate, (Polyolefin)	100/pk	1065-70002

FastRemover for Phospholipid

Rapid and Efficient Removal of Proteins and Phospholipids

The FastRemover for Phospholipid 96-well plate deliver a rapid and effective removal of proteins and phospholipids in plasma and serum samples without sacrificing the recovery of your target analytes.

Features

- Simple & easy protocol to remove proteins and phospholipids.
- High sensitivity analysis is unaffected by contamination from plasticizers or other impurities found in other 96-well plates.
- Removal of microparticle contaminants enables injection to LC/MS/MS directly from the collection plate.
- Removes more than 90% of phospholipids resulting in eliminating ion-suppression.
- Prolong HPLC/UHPLC column lifetime by removing proteins and phospholipids that can damage your column.

Typical Protocol using FastRemover for Phospholipid

The presence of phospholipids in plasma or serum samples is one of the major problems in LC/MS-(MS) analysis. Phospholipids can build up on your MS system and bleed off the HPLC/UHPLC column, causing ion suppression, shifts in retention time and peak shape and necessitating time consuming column and system maintenance. Use of FastRemover for Phospholipid 96-well plate will eliminate these effects and extend the lifetime of your HPLC/UHPLC column and deliver more predictable/accurate mass spectrometry results.

Easy Protocol by FastRemover for Phospholipid

Step 1: Solvent Loading

Add 400 µL of 1% Formic Acid in Acetonitrile into the wells

Step 2: Sample Loading

Add 100 µL of serum sample into the wells

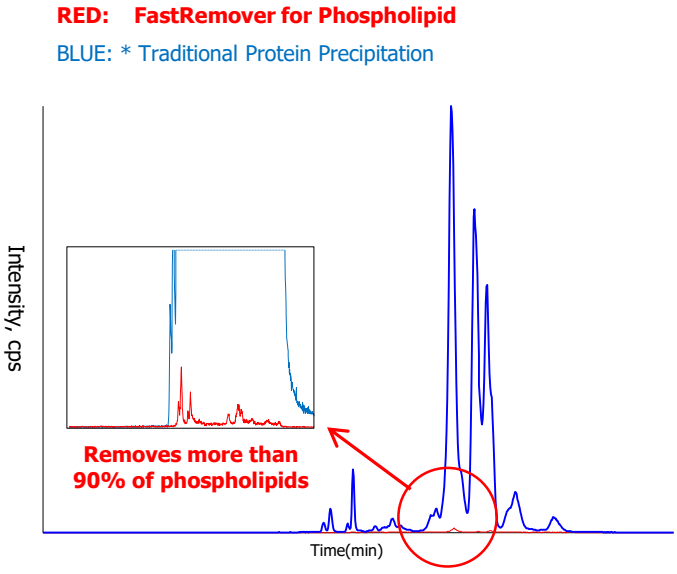
Step 3: Mixing

Aspirate the samples up & down couple of times by a manual pipette or an automated pipetting system may be used to ensure complete mixing

Step 4: Analysis

Collect the extracted sample from the 96-well plate & inject to LC/MS(MS)

*** Traditional Protein Precipitation method:**
Adding acetonitrile to sample and collecting the supernatant layer

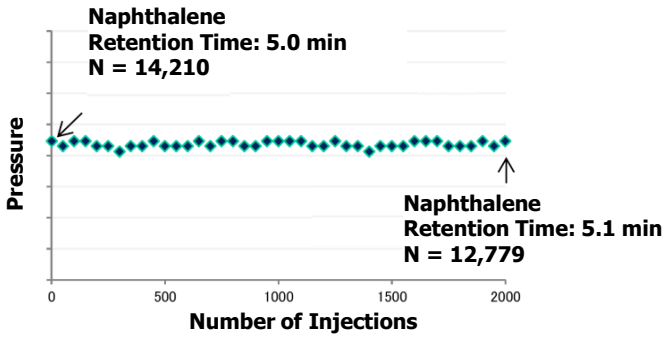


Comparison of Phospholipid Removal between

*** Traditional Protein Precipitation method and FastRemover for Phospholipid**

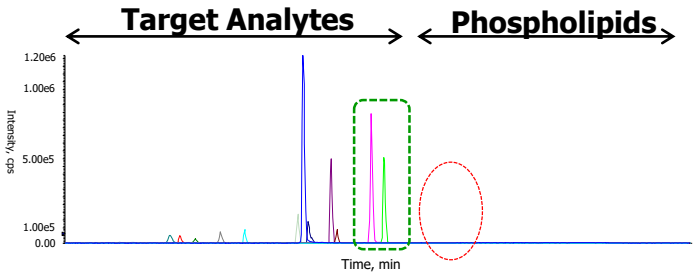
Extend HPLC/UHPLC Column Lifetime

Over the course of multiple injections, phospholipids build up and can lead to reduced column lifetime, showing increase in column back pressure, decrease in column sensitivity and efficiency. The figure on the right illustrates the removal efficiency of phospholipids, proteins and microparticles by FastRemover for Phospholipid.



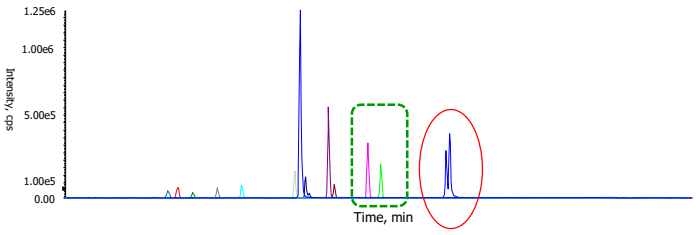
Industry Leading High Recovery for Bioanalysis

As shown below, the FastRemover for Phospholipid 96-well plate deliver a rapid and effective removal of proteins and phospholipids in plasma and serum samples without sacrificing the recovery of your target analytes.



FastRemover for Phospholipid

As shown on the left, not only FastRemover for Phospholipid completely removes phospholipids, but also provide high recovery even for those highly hydrophobic analytes.



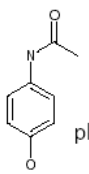
Brand A Phospholipid Removal Plate

Brand A show adsorption of hydrophobic analytes resulting in poor recovery and elution of phospholipids.

Comparison of Recovery Rate using Various Solvents for Deproteinization

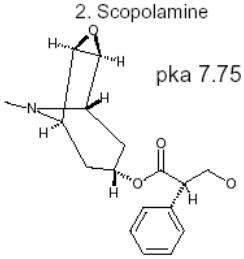
The following seven solvents were used to deproteinate a serum sample. As a result, 0.1% formic acid in 100% acetonitrile showed the best recovery for not only basic, but also for acidic compounds.

1. Acetaminophen



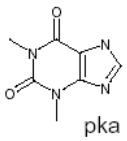
pka 9.38

2. Scopolamine



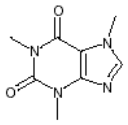
pka 7.75

3. Theophylline



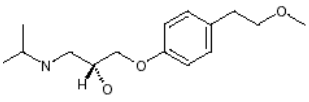
pka 8.81

4. Caffeine



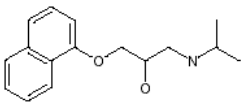
pka 10.4

5. Metoprolol



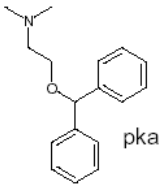
pka 14.09

6. Propranolol



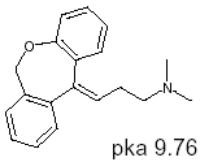
pka 9.42

7. Diphenhydramine



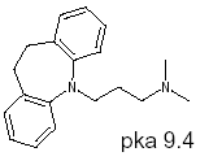
pka 8.98

8. Doxepin



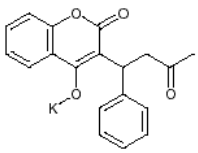
pka 9.76

9. Imipramine



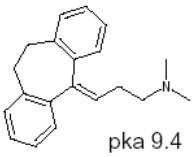
pka 9.4

10. Warfarin



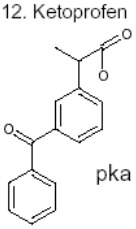
pka 5.08

11. Amitriptyline



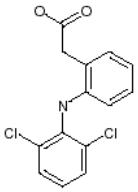
pka 9.4

12. Ketoprofen



pka 4.45

13. Diclofenac



pka 4.15

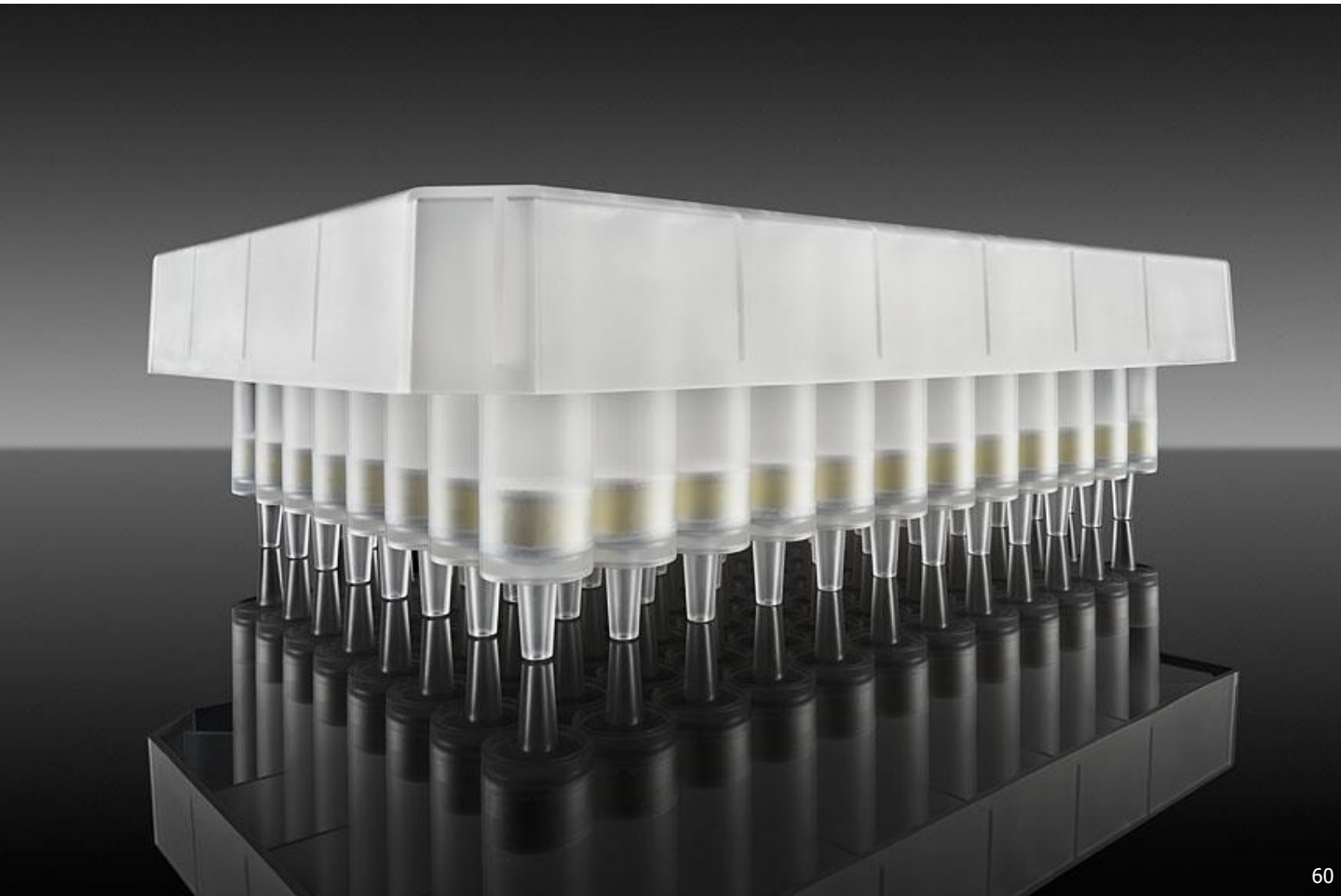
The Best Results

Analyte	CH_3OH	CH_3CN	0.1%HCOOH -CH_3OH	0.1%HCOOH -CH_3CN	1%HCOOH -CH_3CN	0.1%HCOONH4 -CH_3OH	1%HCOONH4 -CH_3OH
1.Acetaminophen	116.2	92.3	106.9	103.5	102.2	2.7	92.2
2.Scopolamine	75.2	87.4	86.0	87.8	83.6	0.9	68.9
3.Theophylline	104.2	95.7	107.2	96.3	94.1	5.1	94.9
4.Caffeine	97.1	98.2	106.4	97.7	90.6	6.0	98.3
5.Metoprolol	90.7	98.4	89.3	90.8	95.5	1.0	76.8
6.Propranolol	88.2	97.4	92.6	106.4	102.9	1.5	78.3
7.Diphenhydramine	89.1	106.6	92.8	106.3	102.5	2.7	75.7
8.Doxepin	76.9	101.6	86.1	107.2	97.7	1.0	64.7
9.Imipraine	80.9	105.8	82.1	99.9	99.7	1.0	72.8
10.Warfarin	85.4	98.6	84.5	103.1	108.4	1.1	80.6
11.Amitriptyline	60.6	103.9	54.8	86.9	90.9	0.9	73.2
12.Ketoprofen	N.D.	39.3	1.4	98.1	108.6	1.9	39.2
13.Diclofenac	8.4	89.2	4.4	102.9	104.9	1.1	67.9

Ordering Information

FastRemover for Phospholipid

Description	Qty	Cat. No.
FastRemover for Phospholipid (0.2 µm)	1 pcs	7510-11021



EVSecond

Exosome Purification Columns

Recent studies have reported significant roles of extracellular vesicle "Exosome" in development and progression of various diseases including cancer metastasis. Therefore exosomes are considered as attractive targets for biomarkers and drug development. However, it remains difficult to isolate high-purity exosomes from biological fluids such as serum. EVSecond is a size exclusion chromatography open column optimized for effective purification of exosomes. Highly-purified exosomes can be easily collected from serum, plasma, or cell culture supernatant.

Features

- Simple gravity-flow handling without ultracentrifugation.
- EVSecond-purified exosomes possess efficient purity for comprehensive miRNA, proteome, and metabolome analysis.
- Exosomes are gently eluted in PBS without structural damage, allowing re-administration experiments of collected exosomes to cells or animals.

Advantages Over Traditional Procedures

- Much higher-purity exosomes can be obtained compared to ultracentrifugation or polymer precipitation methods.
- Unlike immuno-affinity purification using anti-tetraspanin antibodies, whole exosomes can be collected regardless of surface antigen profiles.

Typical Protocol using EVSecond

Gravity-flow is applied to each step.

1. Set columns on GL-SPE EXO fraction rack after mixing beads gently and thoroughly.

⇩

2. Block beads with 0.22 µm filter-purified FBS.

⇩

3. Equilibrate columns with PBS.

⇩

4. Load 50-700 µL 0.22 µm filter-purified samples (serum, plasma, or cell culture supernatant).

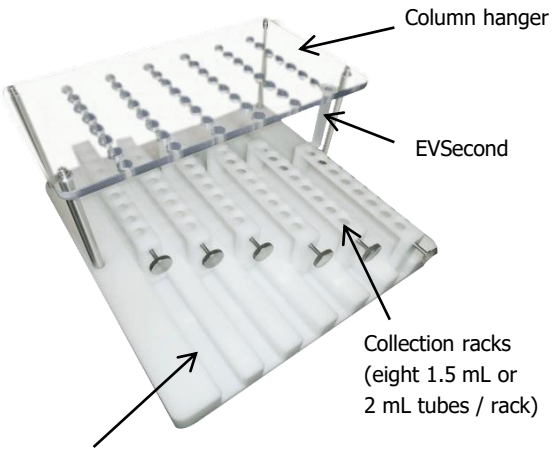
⇩

5. Load PBS and collect appropriate fractions including exosomes.

* Exosome-containing fractions can be identified by western blotting or ELISA experiments detecting tetraspanins (CD9, CD63, CD81, etc.)

GL-SPE EXO Fraction Rack

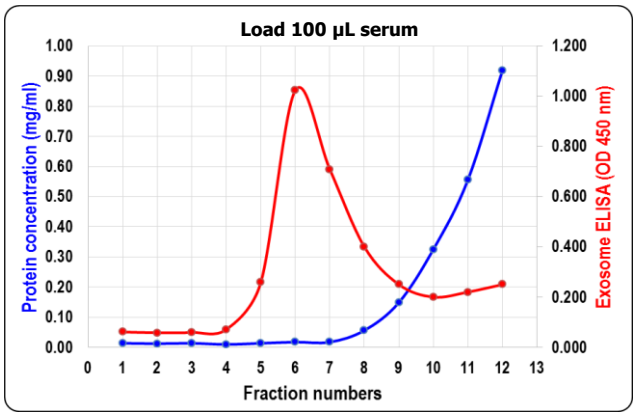
Open column rack optimized for EVSecond.
It helps smooth column handling and fractionation.

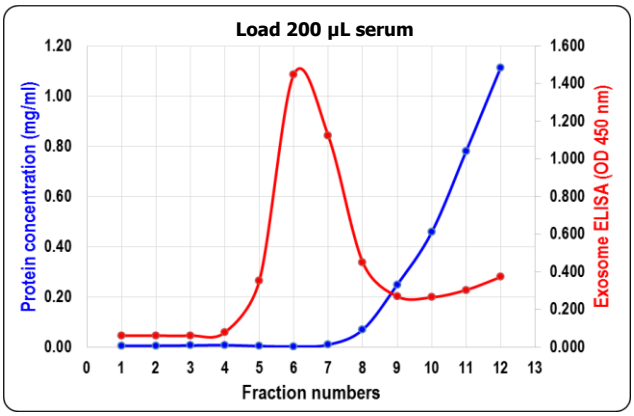


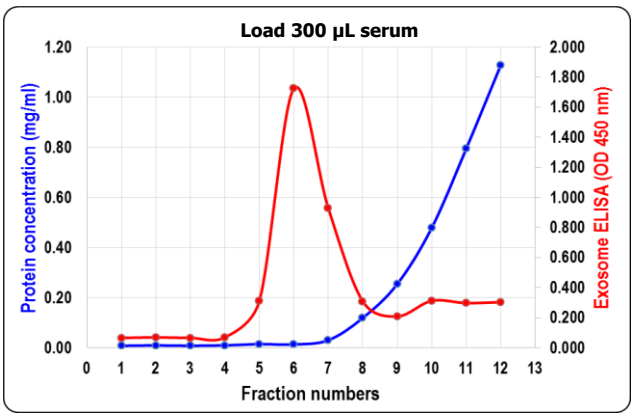
Dimensions: 300(W) × 300(D) × 150(H) mm

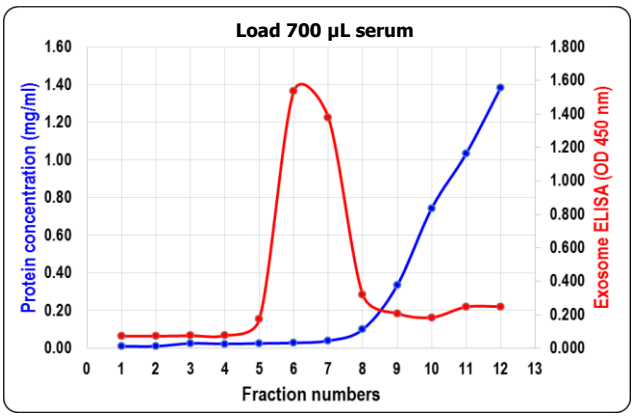
Purification of Exosomes from Human Serum

A large amount of free proteins, metabolites, and nucleotides are involved in serum samples. Insufficient purification of exosomes often causes co-detection of non-exosomal components, leading to incorrect quantification results in omics studies. Exosomes were isolated from 100, 200, 300, or 700 µL of human serum using EVSecond method. Exosomes were clearly separated from serum free proteins such as albumin or immunoglobulins.









(100 µl / fraction)
Red line: CD9-CD9 exosome sandwich ELISA (detecting exosomes)
Blue line: Bradford assay (detecting serum free proteins)
Data provided by Dr. Koji Ueda from Graduate School of Frontier Sciences, The University of Tokyo

Ordering Information

EVSecond

Description	Qty	Cat. No.
EVSecond	10 pcs	5010-21390
	25 pcs	5010-21392
GL-SPE EXO Fraction Rack	1 set	5010-50450

EVSecond was developed based on the cooperation from Dr. Koji Ueda from Graduate School of Frontier Sciences, The University of Tokyo.

MonoFas DNA Purification Kit I

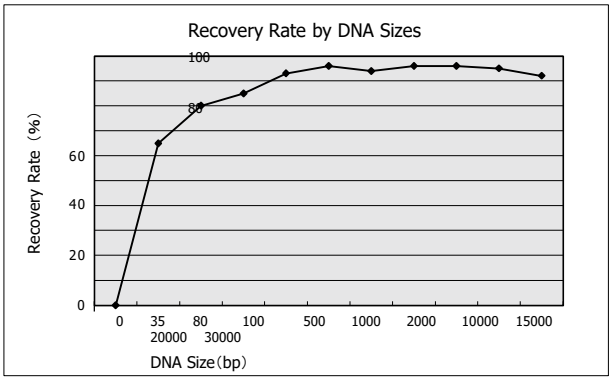
DNA Extraction & Purification

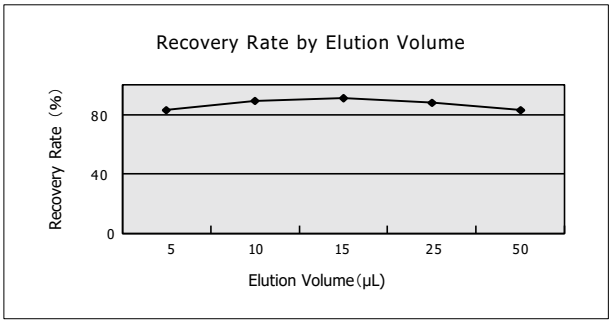
MonoFas DNA Purification Kit I purifies DNA from PCR products and agarose gels. Purified DNA can be used for sequencing, cloning/ligation, restriction digests, etc.

Features

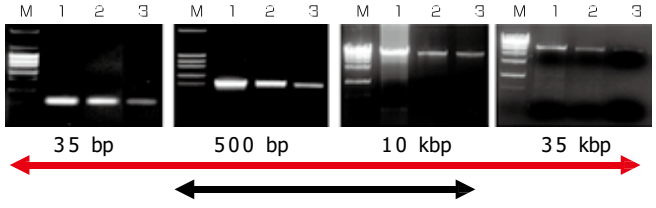
- Multiple Roles – Purifies DNA from PCR matrices or agarose gels.
- Rapid purification in about 4 minutes.
- High recovery rates even from sample volumes as low as 10 µL.
- Purify DNA fragments from 35 bp to 35 kbp.

High Recovery from Trace Volume Samples





Purify DNA fragments from 35bp up to 35kbp

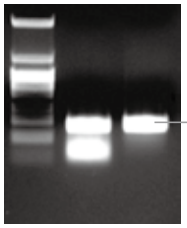


M : pHY Marker 1 : PCR Products
2 : After purification by MonoFas
3 : After purification by commercially available products

MonoFas

Commercially available products

Large Quantities of Agarose Gels can be Processed



MonoFas routinely extracts DNA from up to 1 g of agarose gel at once.

400 bp
M : pHY Marker
1 : Unpurified PCR products 2 : Purified from agarose gel
(MonoFas DNA Purification Kit I)

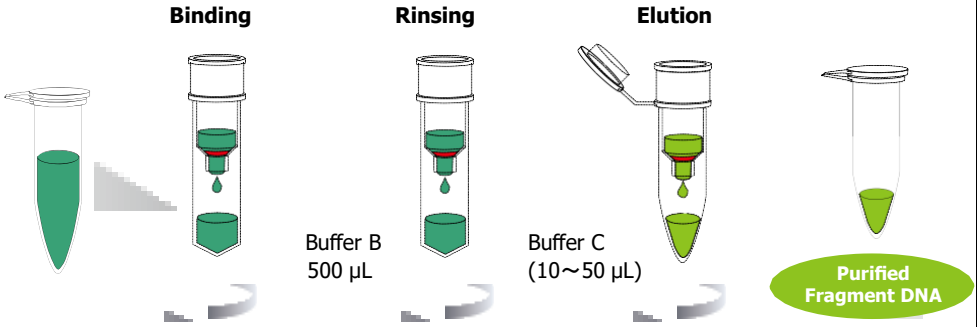
Specifications

Description	Purification from PCR products	Extraction from agarose gel
Time	4 mins	9 mins
Maximum DNA Binding Amount	<10 µg	<10 µg
Maximum Agarose Gel Throughput	—	<1g
Minimum Elution Amount	10 µL	10 µL
Column Volume	1 mL	1 mL
Processable DNA Range	35 bp - 35 kbp	35 bp - 35 kbp
Recovery Rate	>85 %(100 bp - 5 kbp)	>80 %(100 bp - 5 kbp)
	>60 %(5 kbp - 35 kbp)	>50 %(5 kbp - 35 kbp)
Primer Removal Percentage	95 %	—

Typical Protocol using MonoFas DNA Purification Kit I

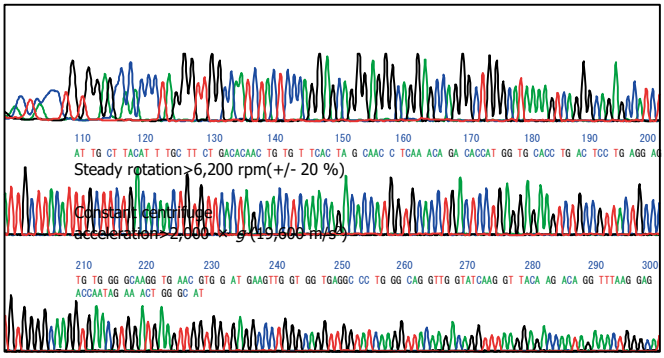
1. Purification of PCR products
Load the PCR products and Buffer A (10 times the volume of PCR products) into the spin column.

2. Extraction from agarose gel
Add the Buffer A (same volume as the agarose gel), dissolve for 5 mins at 60 ℃ then load it into the spin column.



Accurate Sequence Analysis

Greater than 98 % precision by fluorescent sequence method and more than 500 bases can be analyzed.



Condition: Cycle sequencing method with Big Dye Terminator v3.1 manufactured by ABI
Model: ABI 3730 Genetic Analyzer

Easy Centrifuge Operation

2 mins : DNA purification from PCR products
7 mins : DNA purification from agarose gel

Ordering Information

MonoFas DNA Purification Kit I

Description	Qty	Cat. No.
MonoFas DNA Purification Kit1, EXPORT	50 pcs	5010-21530
	100 pcs	5010-21531
	250 pcs	5010-21532

MonoFas DNA Purification Kit III

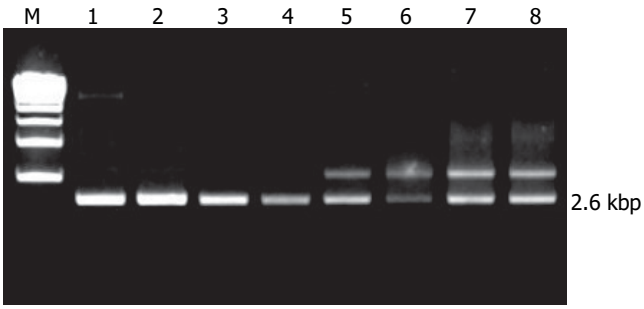
Plasmid DNA Extraction from E.coli

MonoFas Plasmid Extraction Kit III is designed to purify plasmid DNA from E. Col cultures. The extracted plasmid DNA can be used without further purification for sequence analysis, restriction digestion, cloning/ligation, etc.

Features

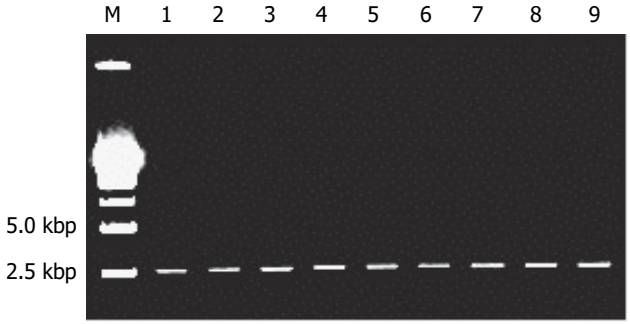
- Rapid Plasma Purification in 8 minutes.
- Highly Purified Plasmid DNA.
- Wide Variety of Functional Groups
- BAC Clone Purification can also be performed.
- Stable Recovery Rate

Extraction of Highly Purified 2.6 kbp Plasmid DNA from 1.5 mL E. Coli (DH5a)



M : DNA Marker
1～4 : MonoFas 5, 6 : Brand A 7, 8 : Brand B

Highly Reproducible Extraction of Low-Copy 2.6 kbp Plasmid from E. Coli (JM109)



M : pHY Marker
1～9 : MonoFas (Low-Copy 2.6 kbp Plasmid

Ordering Information

MonoFas DNA Purification Kit III

Description	Qty	Cat. No.
MonoFas DNA Purification Kit3, EXPORT	50 pcs	5010-21533
	100 pcs	5010-21534
	250 pcs	5010-21535

MonoFas BAC Extraction Kit Ⅴ

Efficient Isolation of BAC, Cosmid DNA

MonoFas Cultured Cell DNA Extraction Kit VI

Isolation of High Yields of Pure DNA in 5 mins without Desalting & Damaging DNA

MonoFas DNA Bacteria Extraction Kit VII

DNA Extraction from Gram Positive & Negative Bacteria

MonoFas DNA Buccal Swabs Extraction Kit VⅢ

DNA Extraction from Buccal Swabs without Desalting

MonoFas DNA Mouse and Rat Tail Extraction Kit IX

Rapid Extraction of DNA from Mouse & Rat Tails

MonoFas DNA Stool Extraction Kit X

Stool Extraction Kit Designed to Extract Bacteria & Epithelial Tissues in Intestine

MonoFas DNA Processed Food Extraction Kit XI

Rapid Extraction of DNA from Processed Food

MonoFas Plant DNA Extraction Kit XII

Rapid Extraction of DNA from Processed Food

For products details, please inquire.

Based on monolithic technology, Merck KGaA, Darmstadt, Germany.

InertSearch Application Notes

Access to the latest pharmaceutical, life science, environmental and food applications at

www.glsciences.com/tech/inertsearch

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