



**Shiseido HPLC Columns**



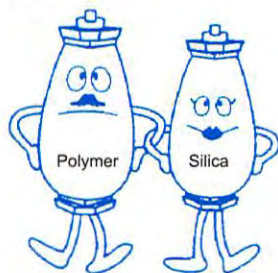
**Catalog**

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# CAPCELL PAK

The revolutionary polymer-coated "capsule type" HPLC column with combined advantages of silica-based and polymer-based columns



**CAPCELL PAK** columns show tremendous durability and reproducibility, being free from undesirable secondary effects typical of other silica-based columns. Their unique synthetic process consists of two steps.

- 1) Surface coating of the silica using a silicone monomer by vapor deposition, resulting in a homogenous polymeric mono-layer.
- 2) Attaching alkyl groups to the coated surface that shields acidic silanols (Fig.1).

This imparts superior mechanical strength as well as extended pH stability, and provides excellent peak profiles for acidic, basic and chelating compounds. CAPCELL PAK exhibits excellent separation and chemical stability, hence the combined benefits of silica supports.

Table 1

	silica type	capsule type	polymer type
pressur durability	○ (20MPa)	○ (20MPa)	× (3.5-7MPa)
basic resistance	△ (pH2-7)	○ (pH1-10)	(pH1-12)
separation	○	◎	△
validation	○		×

◎: excellent ○: good △: marginal ×: bad

## FEATURES

- Polymer coating deactivates residual silanols which cause peak tailing
- Extended pH range (1-10) provides longer lifetime
- Durable and reproducible
- Low column pressure
- Excellent selectivity
- Available in many popular phases
- GLP/GMP validation supported (UG, MG series)

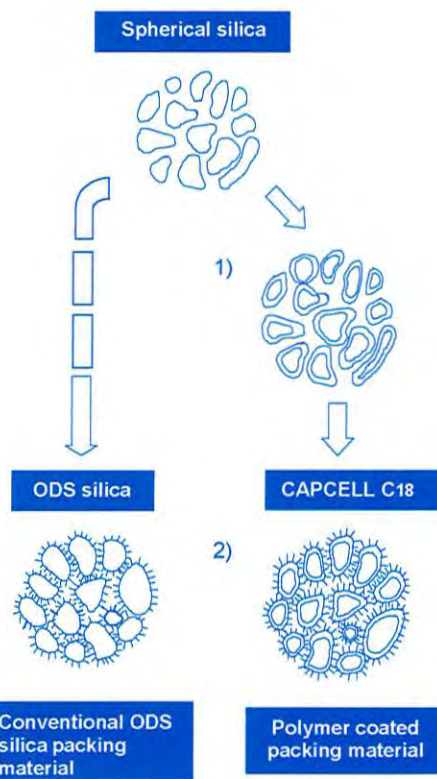


Fig.1

# Advantages of CAPCELL PAK

2

Through its precisely-controlled manufacturing process, **CAPCELL PAK** is a perfectly inert column that neither contains nor releases impurities.

## High-quality raw materials

- High-purity silica  
Metal impurities in silica, the starting material, used for SG, UG, MG Series, ACR, and IF AQ type are less than 5ppm.
- Precisely controlled pore size and distribution
- Spherical silica with an extremely narrow distribution of diameter, which leads to low column pressure.

## Low pressure, easy-to-use

CAPCELL PAK analytical columns (4.6 mm i.d. x 250mm) typically show lower pressures, compared to conventional ODS columns (Fig. 2).

Mobile phase : 70vol% CH<sub>3</sub>OH,  
1.0mL/min, 25°C

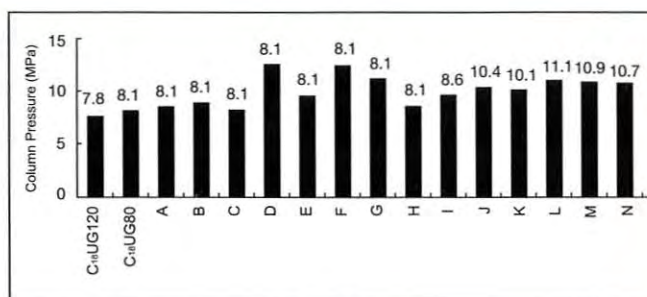
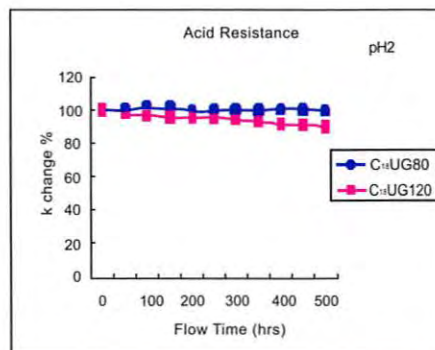
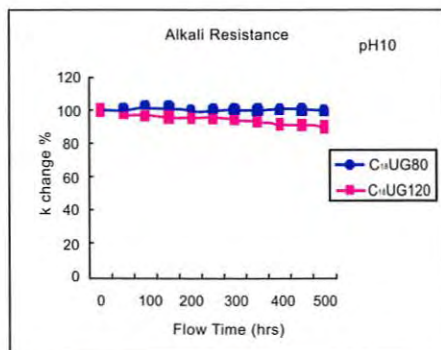


Fig.2

## Durable over a wide pH range (pH 2-10) (ACR, pH 1-10)

### Stability of Retention Factor K'

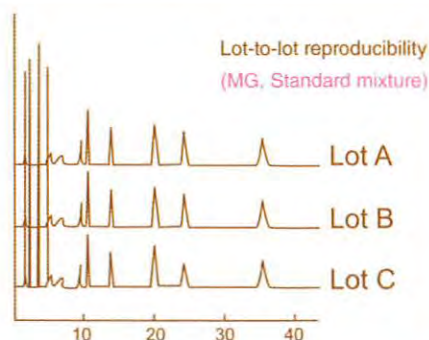


Column : CAPCELL PAK C<sub>18</sub> UG80/120 S5 4.6 mm i.d. x 150mm  
Mobile phase : CH<sub>3</sub>OH/10mmol/L Phosphate buffer=70/30.

Column : CAPCELL PAK C<sub>18</sub> UG80/120 S5 4.6 mm i.d. x150mm  
Mobile phase : CH<sub>3</sub>OH/H<sub>2</sub>O (pH1.0, H<sub>3</sub>PO<sub>4</sub>)=70/30, pH2.0

## Excellent Peak profile and Lot-to-Lot reproducibility

- Symmetrical peaks are obtained even for basic compounds since the undesired effects of residual silanols and metal impurities are kept minimal.
- Excellent lot-to-lot reproducibility.



Most CAPCELL PAK are categorized as L1 in USP

# Evolution of Capcell Pak Technology

3

Ever since the first CAPCELL PAK was introduced in 1987 (AG type), the product line has evolved in terms of the quality of the silica support as well as the polymer coating technology (Table 2). To meet the increased demands in high-throughput analysis, low background analysis, and analysis using harsh mobile phases (e.g., pH<2), CAPCELL PAK with acid resistance (ACR) and different geometries (Mini and capillary) were released to the market. In 2004, Capcell Pak MGII, was launched as a new milestone of CAPCELL PAK, which was developed for generic HPLC method of basic compounds even under neutral condition. In response to the increasing needs of LC-MS and UHPLC analysis, novel modification in particle size and surface bonding with keeping the conventional performance of CAPCELL PAK, gave birth of MGIII, MGIII-H, and IF2 (sub2 $\mu$ m). Now, upon the new challenge in core-shell technology, CAPCELL CORE columns have been launched to extend the CAPCELL PAK product line.

**Table 2**

Polymer-coating Type	Base silica	Polymer coating	pH range	Separation	retention of polar compounds
AG	conventional grade	Mono-layer	2-10	Good	Fair
SG	High purity (metal content: <5ppm)	Mono-layer	2-9	Good	Fair
UG	High purity (metal content: <5ppm)	Homogeneous mono-layer	2-10	Excellent	Fair
MG, MGII MGIII, IF2	High purity (metal content: <5ppm)	Controlled homogeneous mono-layer	2-10	Excellent	Strong
ACR	High purity (metal content: <5ppm)	Reinforced homogeneous mono-layer	1-10	Excellent	Fair
AQ	High purity (metal content: <5ppm)	Controlled homogeneous mono-layer	2-9	Excellent	Excellent (100% water)

## Column List

### General Columns

- CAPCELL CORE (C<sub>18</sub>, AQ, PC, PEP) **NEW!**.....5-6  
Core-shell type columns for improved LC, LC-MS and UHPLC
- CAPCELL PAK C<sub>18</sub> IF2 **NEW!**.....7-8  
A Sub2- $\mu$ m column in response to ultrahigh-pressure analysis
- CAPCELL PAK C<sub>18</sub> MG Series (Capillary, MGII, MGIII, Minimini)..... 9-18  
For improved retention of polar compounds with reduced peak tailing
- CAPCELL PAK UG Series (C<sub>18</sub>, C<sub>8</sub>, Ph, CN, NH<sub>2</sub>, SCX) ..... 19-22  
For fast separation of basic and polar compounds
- CAPCELL PAK ACR (C<sub>18</sub>, Capillary, cartridge) .....23-25  
C<sub>18</sub> column with unprecedented acid resistance
- CAPCELL PAK AQ (C<sub>18</sub>, Capillary, cartridge) .....26-27  
C<sub>18</sub> column operable in 100% water
- CAPCELL PAK CR (1:50, 1:20, 1:4) **NEW!**.....28-29  
A mixing mode of strong cation - exchange and reversed phase.
- CAPCELL PAK C<sub>6</sub> DD.....30-31  
C<sub>6</sub>, yet resistant to acid and alkali
- PC HILIC **NEW!**  
A silica based HILIC column bound with Phosphorycholine (PC) group.....32-33

### Wide-Pore Columns

- PROTEONAVI **NEW!**  
For analytical and preparative separation of protein.....34-35

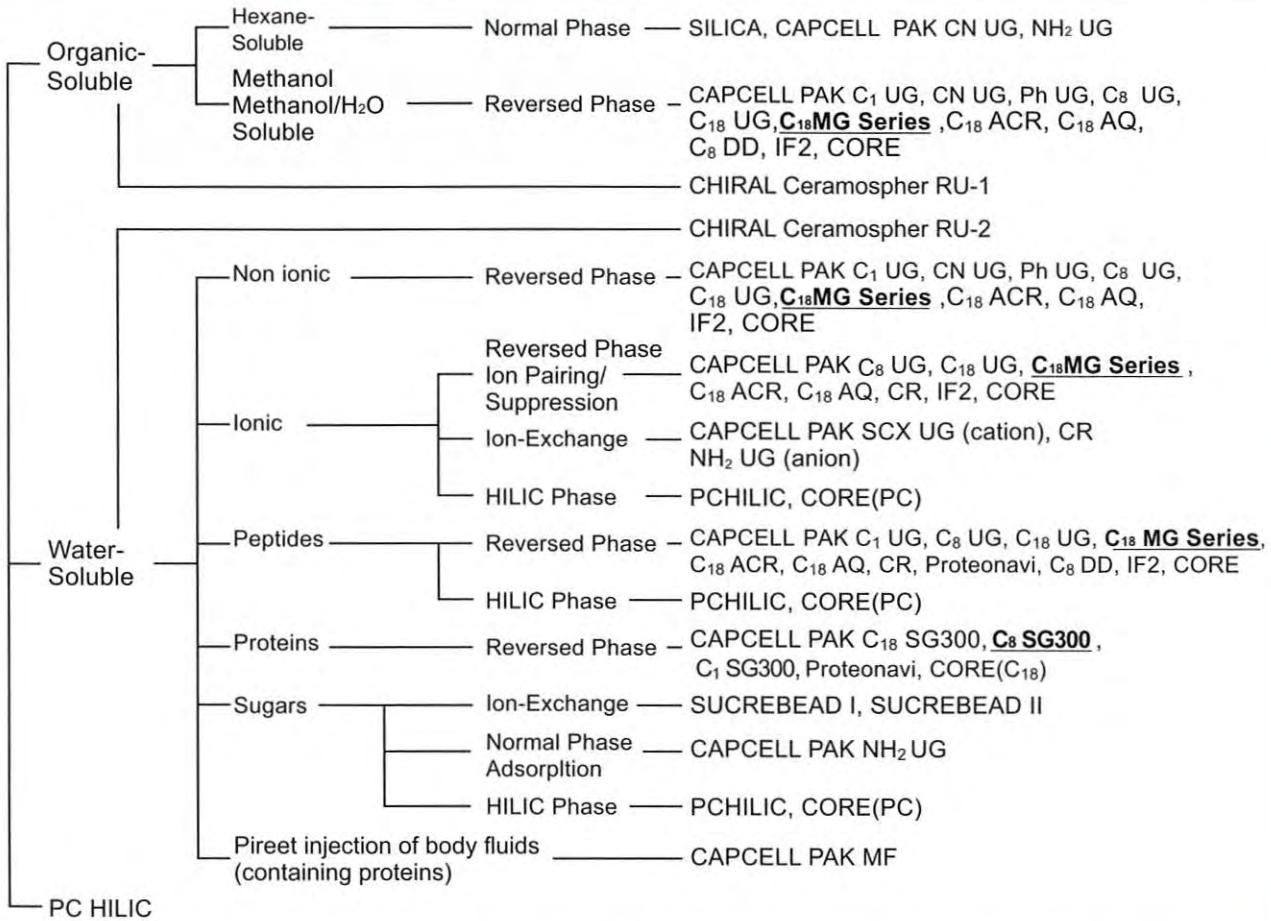
### Core-shell Type Columns

- CAPCELL PAK MF (SCX, C<sub>8</sub>, Ph).....38-40  
For direct injection of serum or plasma without pretreatment
- CHIRAL columns (Ceramospher Ru-1/Ru-2, CD-Ph).....41-42
- SUCREBEAD I, SUCREBEAD II .....43  
For separation of sugars
- REDUCTION Column.....44

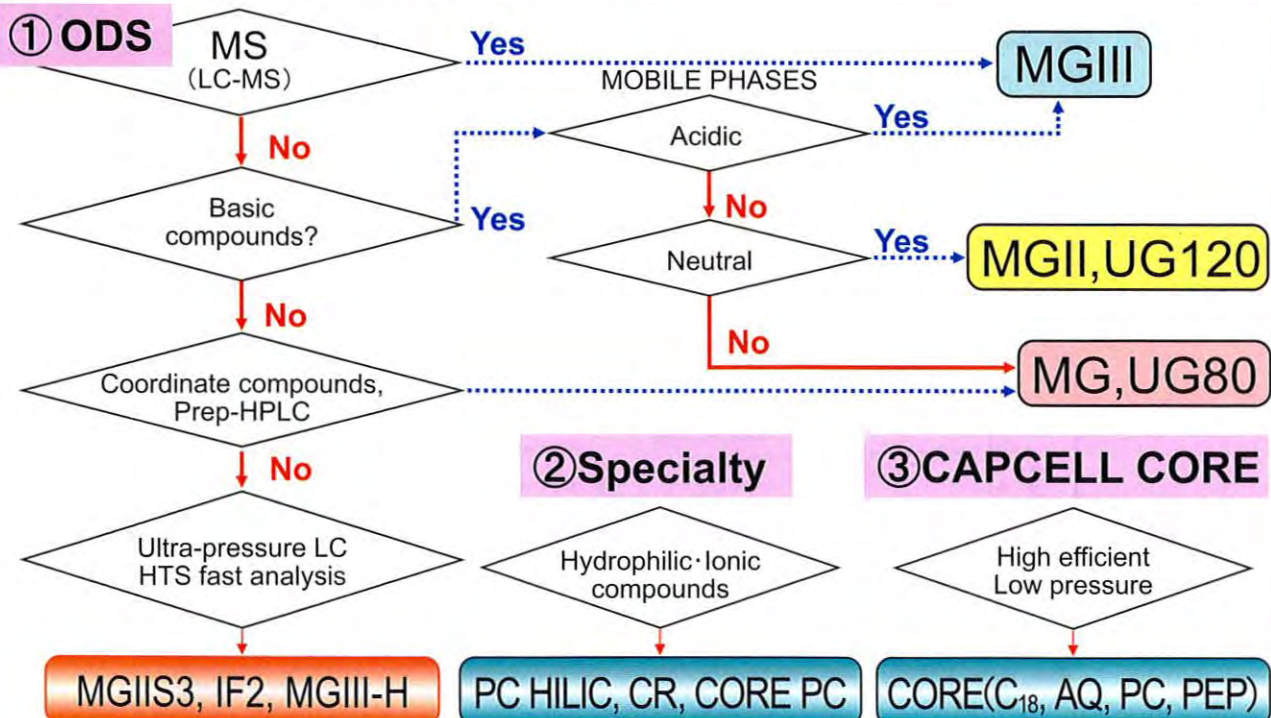
# CAPCELL PAK SELECTION



Capcell Pak columns provide reversed-phase, normal-phase and HILIC (Reverse of reversed-phase) modes ion-exchange separation modes. The following guide will help chromatographers to choose a suitable column that best fits their applications.



## Column selection guide

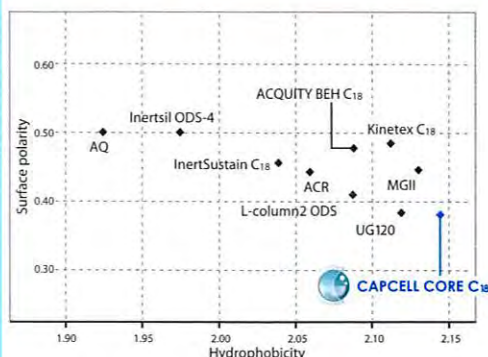


## Polymer-coating type core-shell column

CAPCELL CORE is a polymer-coating type core-shell column of 2.7- $\mu\text{m}$  particle with 1.7- $\mu\text{m}$  solid core and 0.5- $\mu\text{m}$  porous layer. CAPCELL CORE provides high-speed and improved separation in UHPLC as well as conventional HPLC.

## Characteristics

Function group	Micro pore diameter (nm)	Particle size ( $\mu\text{m}$ )	Specific surface area ( $\text{m}^2/\text{g}$ )	C%	Operational pH range	Pressure resistance (MPa)
C <sub>18</sub>	9	2.7	150	7	1.5 – 10	60

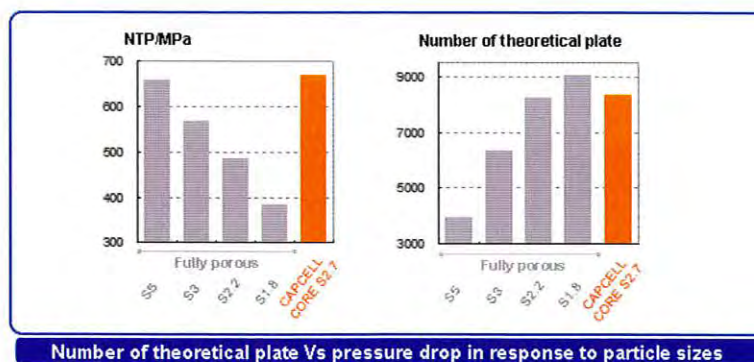


## Evolution of polymer coating technology in core-shell

CAPCELL CORE is a column with minimized undesirable second effect of the silanols by applying polymer coating on the surface of core-shell base material. CAPCELL CORE phase is developed by aiming at full play to high performance of separation derived from the unique structure of core-shell.

## High efficient separation with lower back pressure

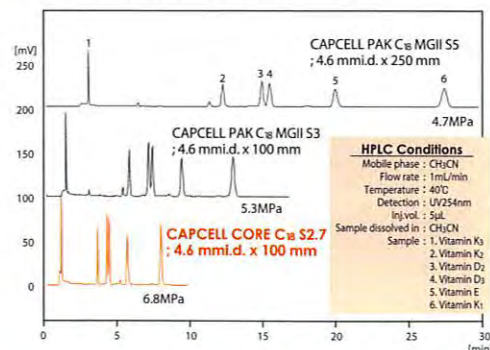
core-shell type CAPCELL CORE overcome the separation impedance of sub 2- $\mu\text{m}$  porous particles with similar high efficiency under a lower back pressure.



Number of theoretical plate Vs pressure drop in response to particle sizes

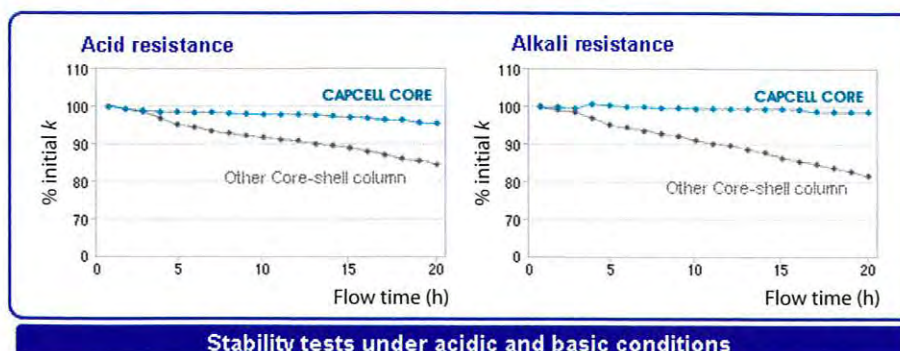
## High-speed high-efficient analysis

CAPCELL CORE C<sub>18</sub> is suggested the improved way to gain the highest separation efficiency at fast analysis even in conventional HPLC.



## Excellent stability under acidic and basic conditions (pH 1.5-10)

Polymer coating technology applied on Capcell Core leads to an excellent stability under acid and basic conditions. Clear differences from other core-shell products can be observed



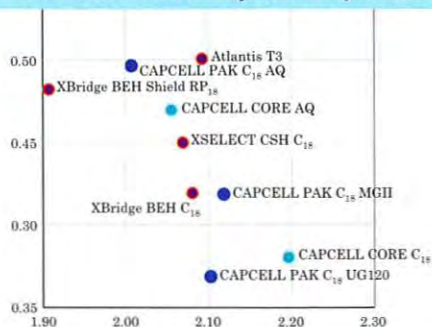
Stability tests under acidic and basic conditions

# CAPCELL CORE AQ

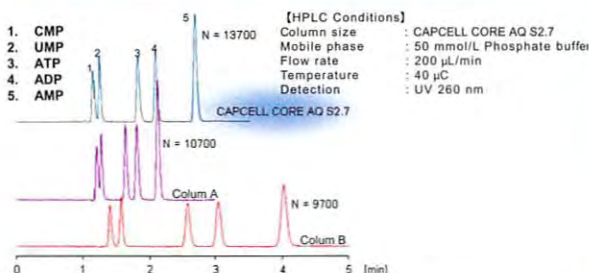
CAPCELL CORE AQ is C<sub>27</sub> column developed for the improved retention of high hydrophilic compounds under 100% aqueous mobile phase at fast analysis.

Function group	Micro pore diameter (nm)	Particle size (μm)	Specific surface area (m <sup>2</sup> /g)	C%	Operational pH range	Pressure resistance (MPa)
C <sub>27</sub>	16	2.7	90	4	2-10	60

## Characterization ~Optimized parameter~



## Well-balanced and efficient separation under 100% buffer



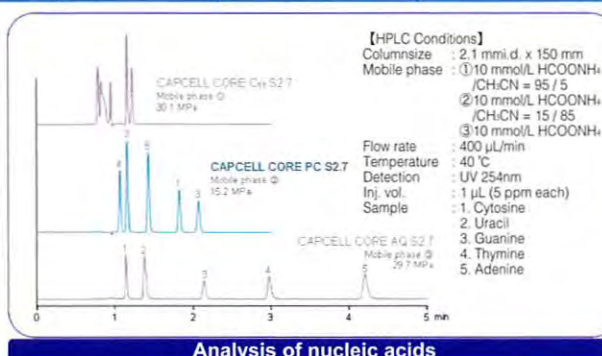
# CAPCELL CORE PC

CAPCELL CORE PC is developed by sophisticated bonding of phosphorylcholine group (PC). The PC column Provides HILIC-mode retention of very polar compounds.

Function group	Micro pore diameter (nm)	Particle size (μm)	Specific surface area (m <sup>2</sup> /g)	C%	Operational pH range	Pressure resistance (MPa)
PC	9	2.7	150	—	2-7.5	60

## Synergy of PC technology and CAPCELL CORE

CAPCELL CORE PC retains high hydrophilic compounds under organic solvent-rich mobile phase where C<sub>18</sub> has no retention. Core-shell type PC is a good alternative for UHPLC (sub 2-μm) HILIC mode and provides improved LC-MS for high hydrophilic compounds.



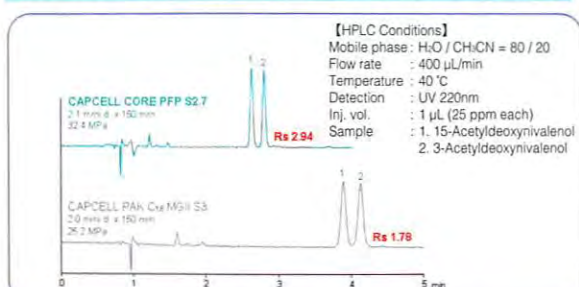
Analysis of nucleic acids

# CAPCELL CORE PFP

CAPCELL CORE PFP is a novel phase with function group of pentafluorophenyl group. It provides improved separation capacity by specific retention of fluorine compounds and position isomers.

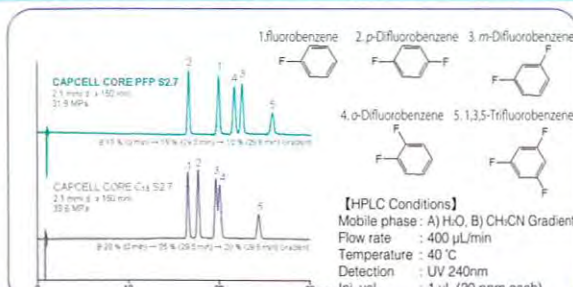
Function group	Micro pore diameter (nm)	Particle size (μm)	Specific surface area (m <sup>2</sup> /g)	C%	Operational pH range	Pressure resistance (MPa)
PFP	9	2.7	150	5	2-9	60

## Specific selectivity of position isomer in UHPLC



Separation of position isomer

## Best choice for analysis of fluorine compounds



Analysis of fluorine compounds





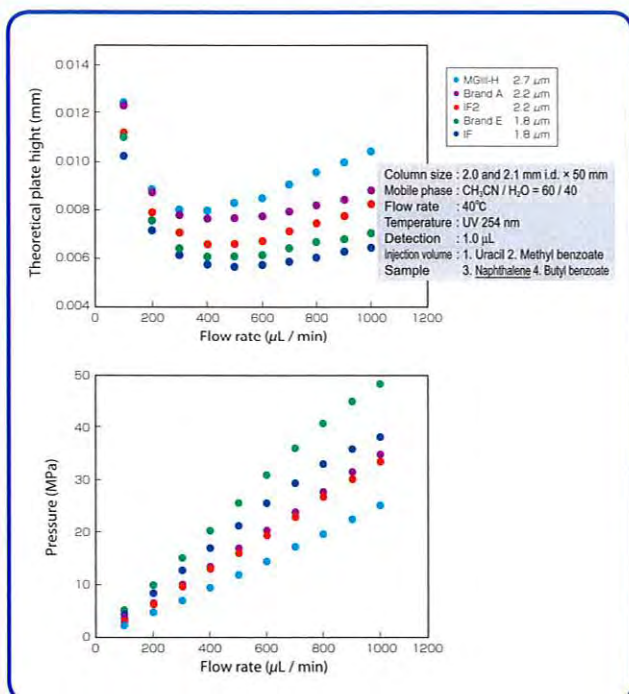
Durability is an indispensable quality to columns for ultra-high-speed high-pressure separation. A short lifetime under high pressure, and therefore, a high column cost would make high-pressure separation less attractive to chromatographers.

## CAPCELL PAK C<sub>18</sub> IF2

In response to such customer's needs, CAPCELL PAK C<sub>18</sub> IF2 has been developed. IF2 enables excellent peak shape of basic compounds as well as the separation efficiency, while showing unsurpassed durability, hence offers the best choice for real ultra-high-speed, high-pressure separation

### Properties

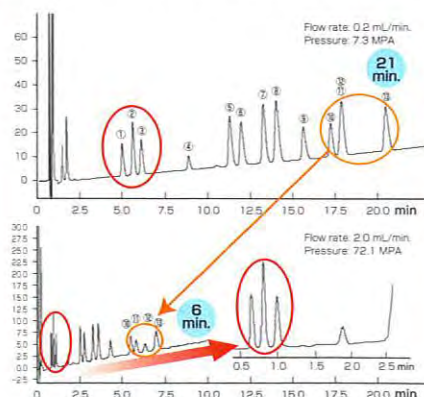
Function group	Pore size (nm)	Average Particle size (μm)	Specific surface area (m <sup>2</sup> /g)	C%	Density (μmol/m <sup>2</sup> )	Applicable pH range
C <sub>18</sub>	8	2.2	480	15.5	1.5	2-9



van Deemter Plots

### Quick and Sharp Elution of Basic Compounds

The CAPCELL PAK IF2 showing sharp peaks for basic analytes, provides excellent peak shape and separation efficiency even at ten-time greater flow rate, while enables the analytes to elute quickly.

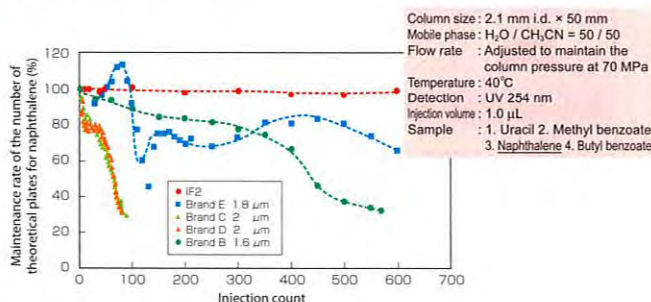


Column size: 2.1 mm i.d. × 50 mm  
 Mobile phase: A, 0.1% formic acid in water  
 B, 0.1% formic acid in acetonitrile  
 B, conc 13.0 to 20.7% (0 to 22min.)  
 Flow rate: 0.2 mL/min., 2.0 mL/min.  
 Temperature: 50°C  
 Detection: UV 220 nm  
 Injection volume: 1.0 μL  
 Sample: ① Tetracaine (40ppm)  
 ② Diphenhydramine (40ppm)  
 ③ Diflunisal (40ppm)  
 ④ Promethazine (40ppm)  
 ⑤ Desipramine (40ppm)  
 ⑥ Imipramine (40ppm)  
 ⑦ Nortriptyline (40ppm)  
 ⑧ Amitriptyline (40ppm)  
 ⑨ Trimipramine (40ppm)  
 ⑩ Chlorpromazine (40ppm)  
 ⑪ Nicardipine (40ppm)  
 ⑫ Verapamil (40ppm)  
 ⑬ Clomipramine (40ppm)

### Unsurpassed Durability against Pressure up to 100 MPa

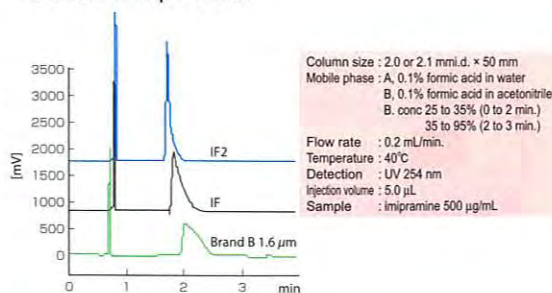
The graph below shows the durability comparison measured under a pressure of 70 MPa by adjusting the flow rate of each column. Among the columns whose specifications of withstand pressure are known as more than 70 MPa, CAPCELL PAK IF2 with pressure resistance up to 100 MPa, shows outstanding durability as a UHPLC column truly ideal for ultra-high-speed high-pressure separation.

Packing technology is an important process that determines the quality of the column. To achieve such excellent durability, we used considerable ingenuity in the packing of the CAPCELL PAK IF2.



### Higher Loadability than Existing Products

We injected 50-time more concentrated imipramine to compare the peak shape. The CAPCELL PAK IF2, which is suitable for the separation of basic compounds, sharply elutes even high concentrations of basic compounds.



### CAPCELL PAK C<sub>18</sub> IF2 S2

Catalog No	Inner Diameter (mm)	Length (mm)
92883	2.1	20
92885	2.1	50
92887	2.1	100

# UHPLC column for Ultra-High-Speed LC-MS analysis



With the improved performance of mass spectrometers, the requirements for columns are divided into two properties: capability of fast crude separation and a superior separation efficiency that enables highly-sensitive analysis of a smaller amount of samples. Both of them require high pressure resistance.

## CAPCELL PAK C<sub>18</sub> MGIII-H

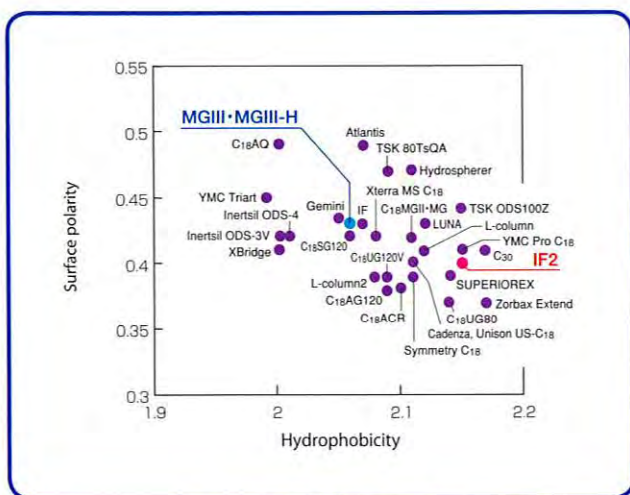
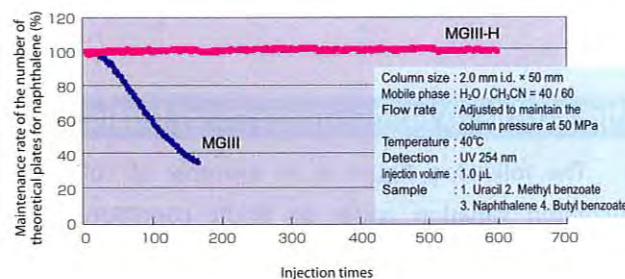
CAPCELL PAK MGIII-H is an evolution of MGIII in response to such needs. MGIII-H enables operation pressure up to 50 MPa, showing outstanding durability, hence offers improved high-speed LC-MS of basic compounds with flexible pressure resistance.

### Properties

Function group	Pore size (nm)	Average Particle size (μm)	Specific surface area (m <sup>2</sup> /g)	C%	Density (μmol/m <sup>2</sup> )	Applicable pH range
C <sub>18</sub>	10	2.7	300	15	2.3	2-9

### Unsurpassed Durability against Pressure up to 100 MPa

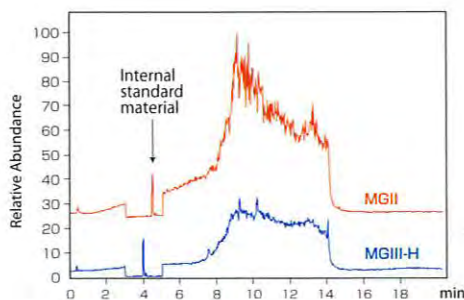
The durability is determined under 50 MPa by adjusting the flow rate of each column. The CAPCELL PAK MGIII-H maintains the number of theoretical plates even after 600 times of injection, so can be used with confidence.



Parameter map

### Minimized Bleeding

As another effect of the special preconditioning, the background (bleeding) most affecting the high sensitivity range has been drastically reduced.



### Specifications for MG Series Columns

We conduct strict control by adding the symmetry of the peak shape and the retention coefficient for amitriptyline, which is sensitive to silanol, to the specifications.

Test item	MGIII	MGII	MG
Pyridine/Pheno	As (Py): 0.90-1.50 As (Ph): 0.90-1.20	Shipment standard specified	Shipment standard specified
Quinizarin	As: 0.90-1.40	—	—
Amitriptyline (neutral condition)	—	As: 0.90-1.30	—
Amitriptyline (acidic condition)	As: 0.90-1.30 k: 1.3-1.6	—	—

### Excellent Reproducibility for Basic Compounds under Acidic Conditions

The lot-to-lot reproducibility is an issue for isocratic analysis under acidic conditions, which is often conducted as the LC-MS analysis of basic compounds. The MGIII-H is developed with special conditioning similarly to that of the MGIII during the manufacturing processes, therefore can provide improved performance with confidence.

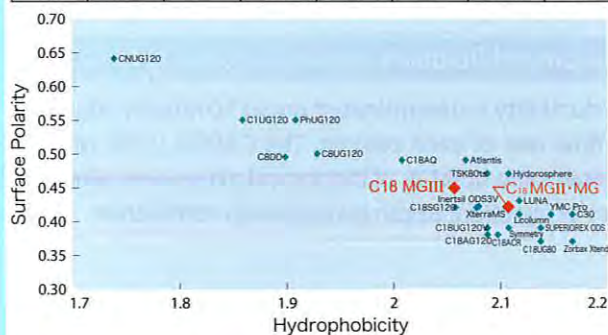
### CAPCELL PAK C<sub>18</sub> MGIII-H S3

Catalog No	Inner Diameter (mm)	Length (mm)
92782	2.0	20
92784	2.0	50
92786	2.0	100

The CAPCELL PAK C<sub>18</sub> MGIII, the third generation of the MG series, is developed to overcome the column-to-column variation in retention of basic compounds under an acidic condition. The quality of MGIII will help develop improved methods in various LC-MS applications.

### Characteristics and parameter mapping

Function group	Pore size (nm)	Particle size (μm)	Specific surface (m <sup>2</sup> /g)	C%	Density (μmol/m <sup>2</sup> )	pH	USP
C <sub>18</sub>	10	5	260	15	2.7	2-10	L1
C <sub>18</sub>	10	3	300	15	2.3	2-10	L1



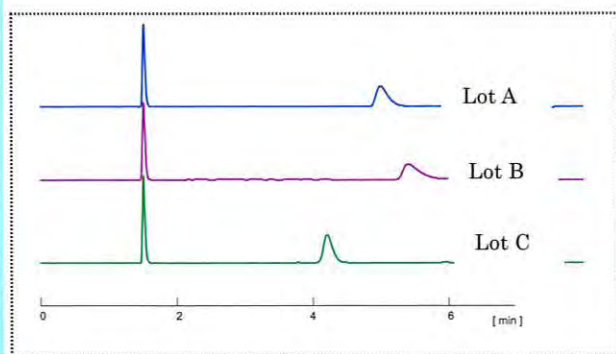
### Comparison of Shiseido HPLC columns

Feature	MGIII	MGII	MG	UG120	ACR	AQ
High-purity silica	✓✓	✓✓			✓✓	✓✓
Highly basic compounds (under acidic mobile phases)	✓✓✓	✓✓	✓✓	✓✓	✓✓	✓✓
Highly basic compounds (under neutral mobile phases)	✓✓	✓✓✓	n/a	n/a	n/a	n/a
LC-MS/MS	✓✓✓	✓✓	✓	✓	✓	✓
Multi-component analysis	✓✓	✓✓	✓✓	✓	✓✓	✓✓
High-polarity compounds	✓✓	✓✓	✓✓	✓	✓	✓✓✓
Pyridine/phenol test	✓✓	✓✓	✓✓	✓✓	✓✓	✓✓
Quinizarin	✓✓	—	—	—	—	—
Acid durability	✓✓	✓✓	✓✓	✓✓	✓✓✓	✓✓
Basic durability	✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓
Semi-preparative scale	—	✓✓	✓✓	✓✓	✓✓	✓✓
3-μm particle type	✓✓	✓✓	✓✓	✓✓	✓✓	✓✓

✓✓✓: excellent ✓✓: good(applicable) n/a: not applicable

### The problem in the analysis of basic compounds under an acidic condition

The following figure is an example of column-to-column variation under an acidic condition. The compound used here was amitriptyline, a highly basic compound used for the USP evaluation method. The results were obtained under an isocratic condition (0.1% formic acid/methanol). Retention times of the three columns (Column A, anonymous) were found very different under the mobile phase that was one of the most common in LC-MS. The similar tendency was observed in many other columns.

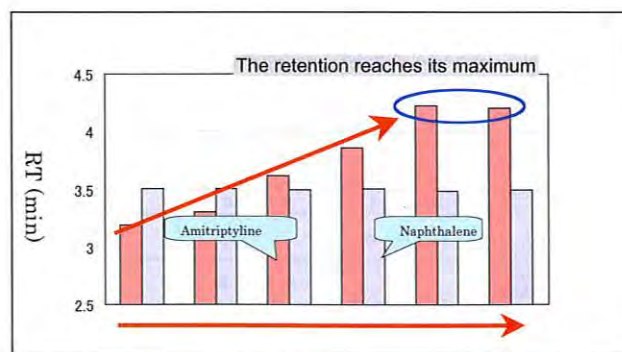


Lot variation under an acidic condition

#### HPLC Conditions

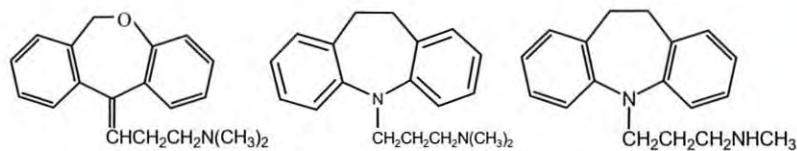
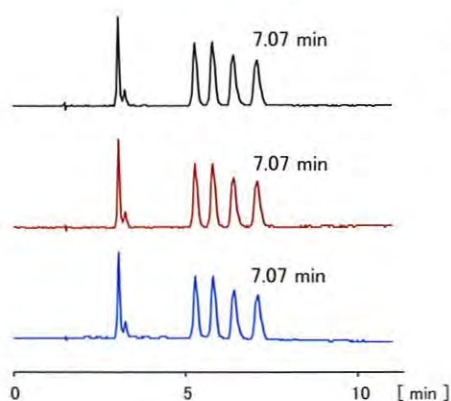
Column : Column A 4.6 mm i.d. x 150 mm  
 Mobile phase : CH<sub>3</sub>OH / H<sub>2</sub>O / HCOOH = 500 / 500 / 1  
 Flow rate : 1 mL/min  
 Temperature : 40 °C  
 Detection : UV, 254 nm  
 Inj.vol. : 5 μL  
 Sample dissolved in : H<sub>2</sub>O (50 μg/mL)

Based on our previous studies, we found the responsible factor was related to the synthetic byproducts and the residues of impurities from reagents used for the synthetic process. We accordingly applied a special pre-conditioning process to the column production, which provided the stable retention to both amitriptyline and naphthalene.

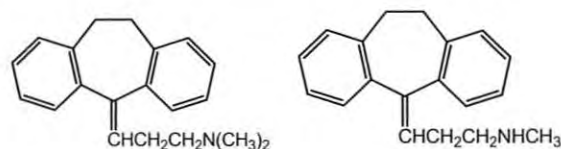


Optimization of pre-conditioning (PC) time

## MGIII...excellent reproducibility under an acidic condition



1. Doxepine (M.W. 279.4) 2. Imipramine (M.W.280.4) 3. Desipramine (M.W. 266.4)

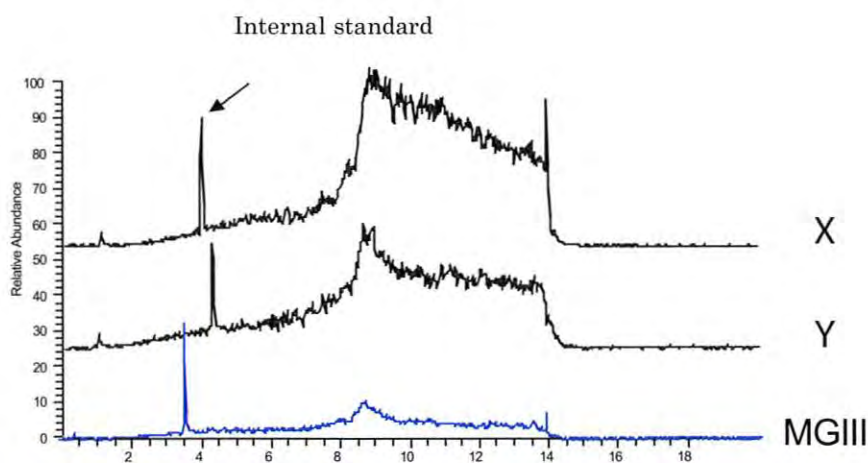


4. Amitriptyline (M.W. 277.4) 5. Nortriptyline (M.W. 184.2)

Column	: CAPCELL PAK C <sub>18</sub> MGIII S5 4.6 mm i.d. x 150 mm
Mobile phase	: CH <sub>3</sub> OH / H <sub>2</sub> O / HCOOH=450 / 550 / 1
Flow rate	: 1 mL/min
Temperature	: 40 °C
Detection	: UV, 254 nm
Inj.vol.	: 1 μL
Sample dissolved in	: H <sub>2</sub> O (50 μg/mL)

## MGIII...low-bleeding column

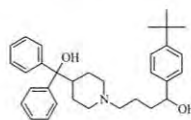
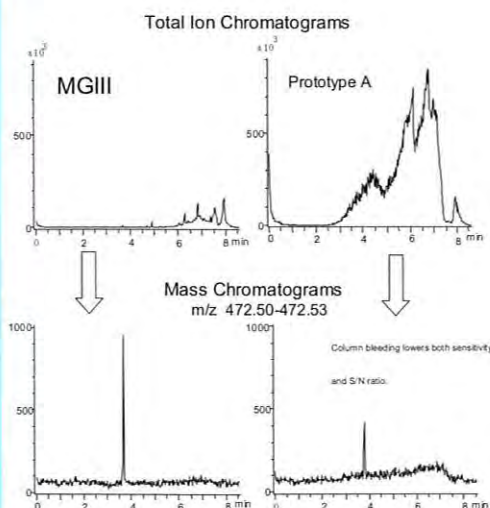
Total ion chromatograms (TICs) were compared among different Shiseido columns under a validated gradient condition. The PC process was found to reduce the amount of column bleeding to a large extent, especially in the region for highly hydrophobic compounds.



Comparison of column bleeding

## “Column bleeding” influences LC-MS sensitivity (Ion suppression)

Column bleeding not only interferes an analyte signal by its components with close  $m/z$  values, but may lower an intensity of the analyte peak itself. The effect of column bleeding has been extensively studied throughout the development of the MGIII series.



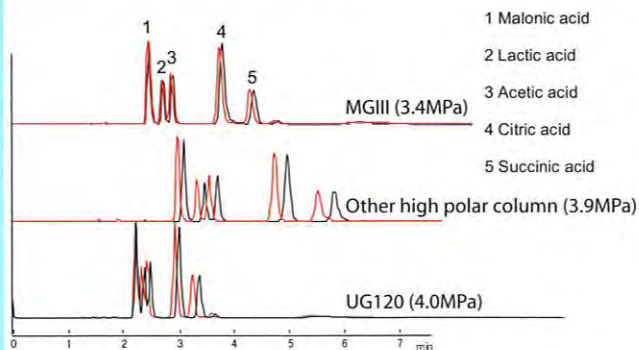
Terfenadine  
(M.W. 471.31)

Column size : 2.0 mm i.d. x 50 mm  
 Mobile phase : A) 0.1 vol % HCOOH  
 B) CH<sub>3</sub>CN  
 B 10% (0min) -> 100% (5.0 min) -> 100%  
 (6.0 min) -> 10% (6.1 min) Gradient  
 Flow rate : 200  $\mu$ L/min  
 Temperature : 40  $^{\circ}$ C  
 Detection : MS ESI Positive  
 Inj. vol. : 2  $\mu$ L  
 Sample dissolved in: Methanol (10 ng/mL)

Influence of column bleeding on ion intensity of analyte (Ion suppression)

## MGIII...wide usage from high-polarity compounds to low-polarity ones

MG Series columns used to be categorized as “medium polar”. MGIII, being treated with the PC process, has a higher polarity than previous MG columns. Separation of small organic acids was attempted to evaluate the polarity of MGIII, in comparison with another Shiseido column and one of the competitor’s high-polarity columns.

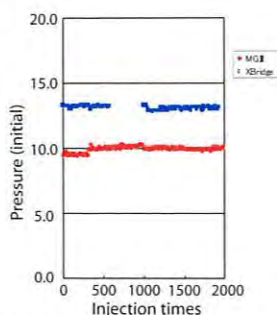
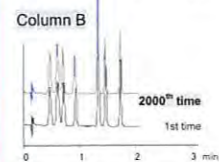
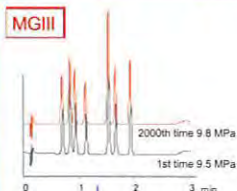


Column size : 2.0&2.1 mm i.d. x 150 mm  
 Mobile phase : 0.1 vol% H<sub>3</sub>PO<sub>4</sub> / CH<sub>3</sub>CN = 99.5 / 0.5  
 Flow rate : 200  $\mu$ L/min  
 Temp. : 40  $^{\circ}$ C  
 Detection : UV 210 nm  
 Inj. vol. : 2.0  $\mu$ L  
 Sample dissolved in : Mobile phase ( 500  $\mu$ g/mL )

Separation of organic acids

## MGIII...low pressure and high durability

MGIII



Pressure change in continuous operations

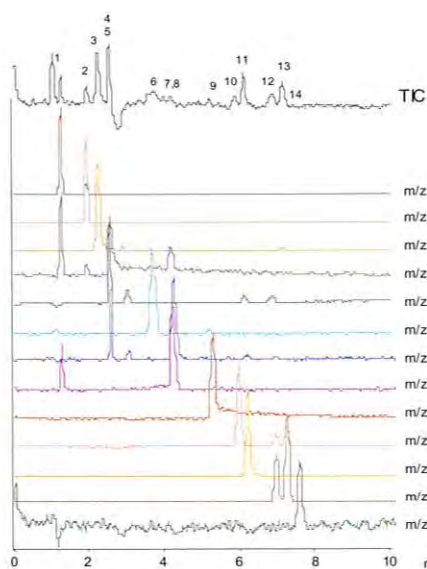
- Low pressure and high durability. A similar separation efficiency to be obtained with 25% less pressure.
- A new end fitting design (filter pore size, shape of through pore) to meet the new column specifications.
- A new process to finish the inner wall of the empty column.

## LC-MS analysis of fourteen nucleic acid-related compounds

MGIII is suitable for separations of polar compounds. Nucleic acid-related compounds, which are generally considered hard to retain in  $C_{18}$  columns, were also well separated with MGIII.

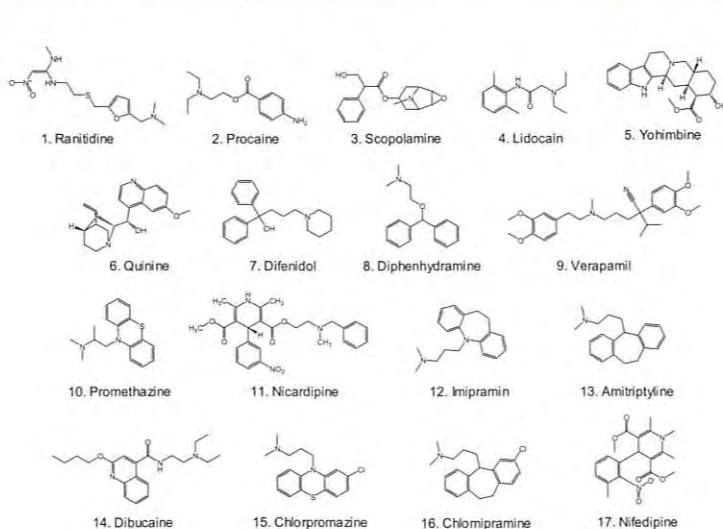
### LC-MS Conditions

Column : CAPCELL PAK  $C_{18}$  MGIII S5 ; 2.0 mm i.d. x 150 mm  
 Mobile phase : A) 0.1 vol%  $CH_3COOH$  B)  $CH_3OH$   
 B 2% (0 min) -> 20% (10 min) -> 2% (10 min) Gradient  
 Flow rate : 200  $\mu L/min$   
 Temperature : 40  $^{\circ}C$   
 Detection : MS ESI Positive  
 Inj.vol. : 2  $\mu L$   
 Sample : guanine (1000  $\mu g/mL$  in 0.1 mol/L KOH), xanthin (1000  $\mu g/mL$  in 0.1 mol/L NaOH), uridine (500  $\mu g/mL$  in 1% HCOOH), deoxyadenosine (1000  $\mu g/mL$  in 1% HCOOH) and other solutions (1000  $\mu g/mL$  in 1% HCOOH) were mixed together, and diluted to 1 mL with water.  
 Sonication (30 min) is necessary to dissolve some of the compounds.

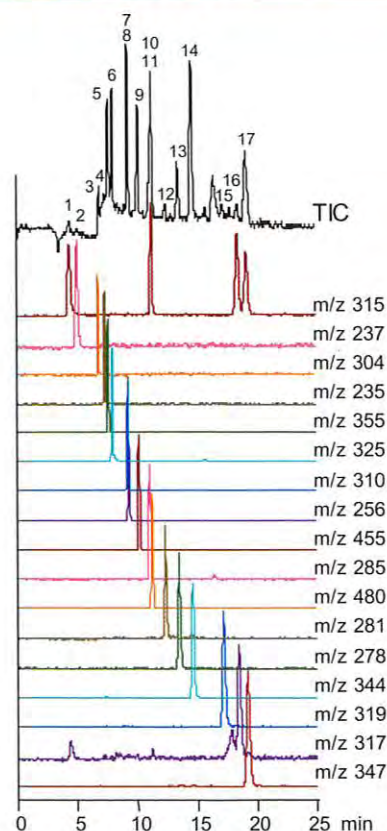


1. Cytosine (MW. 111.1)
2. Deoxycytidine (MW. 227.2)
3. Adenine (MW. 135.1)
4. Uracil (MW. 112.1)
5. Guanine (MW. 151.1)
6. Hypoxanthine (MW. 136.1)
7. Xanthine (MW. 152.1)
8. Uridine (MW. 244.2)
9. Thymine (MW. 126.1)
10. Inosine (MW. 268.2)
11. Guanosine (MW. 283.2)
12. Adenosine (MW. 267.2)
13. Deoxyguanosine (MW. 267.2)
14. Deoxyadenosine (MW. 251.2)

## Simultaneous separation of seventeen basic compounds with MGIII column



Column : CAPCELL PAK  $C_{18}$  MGIII S5 ; 2.0 mm i.d. x 250 mm  
 Mobile phase : A) 10 mmol/L  $HCOONH_4$  contained 0.1 vol% HCOOH B)  $CH_3OH$   
 B 20% (0 min) -> 20% (3 min) -> 55% (3 min) -> 55% (25 min) -> 20% (25 min) Gradient  
 Flow rate : 200  $\mu L/min$   
 Temperature : 40  $^{\circ}C$   
 Detect : MS ESI Positive  
 Inj.vol. : 2  $\mu L$   
 Sample : Methanol (Diphenhydramine: 10  $\mu g/mL$ , Other sixteen compounds: 2  $\mu g/mL$ )



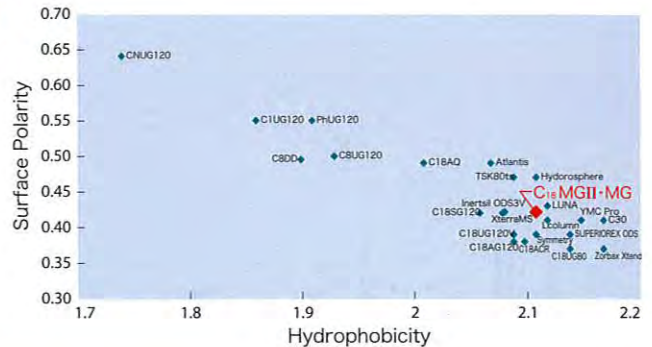


CAPCELL PAK MG II is based on high-purity silica support, being one of the MG series columns. MG II is designed to provide excellent peak shapes for basic compounds under neutral mobile phase conditions. Its outstanding "silanol-shielding" power was generated by the original polymer-coating technology.

## Characteristics and parameter mapping

The general characteristics of CAPCELL PAK C<sub>18</sub> MG II are same as that of MG. MG II is an easy-to-use column with moderate hydrophobicity and moderate surface polarity.

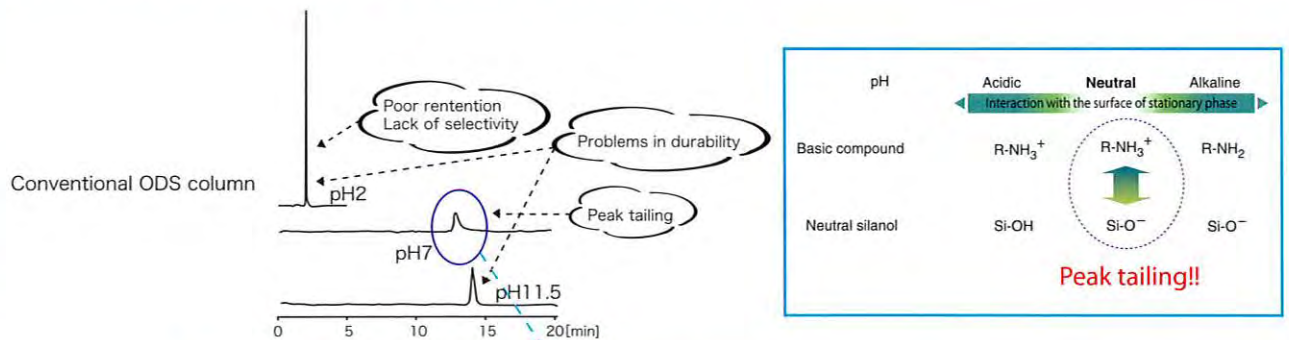
Function group	Pore size (nm)	Particle size (μm)	Specific surface area (m <sup>2</sup> /g)	Carbon%	Alky group density (μmol/m <sup>2</sup> )	pH	USP
C <sub>18</sub>	10	5	260	15	2.7	2-10	L1
C <sub>18</sub>	10	3	300	15	2.3	2-10	L1



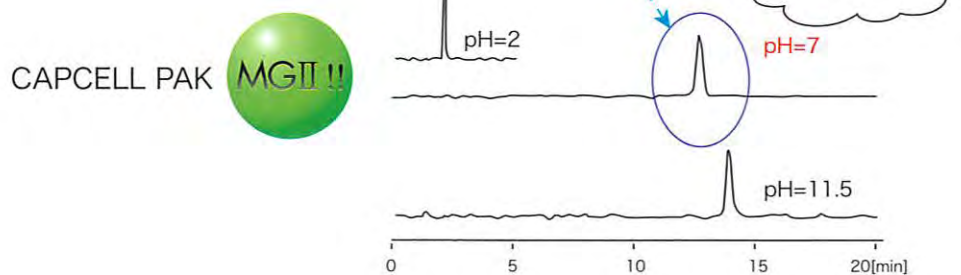
## Why do we need a good column to be used under neutral mobile phase conditions?

Many physiologically active compounds and their metabolites possess a basic nature. Chromatographers keep on seeking a good column for such compounds, free from peak shape deterioration caused by silica's acidity, the inherent nature of silica-based columns.

<Problems in analysis of basic compounds under acidic, basic, and neutral condition>



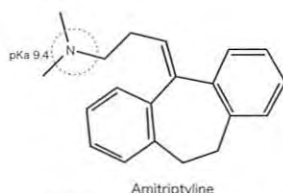
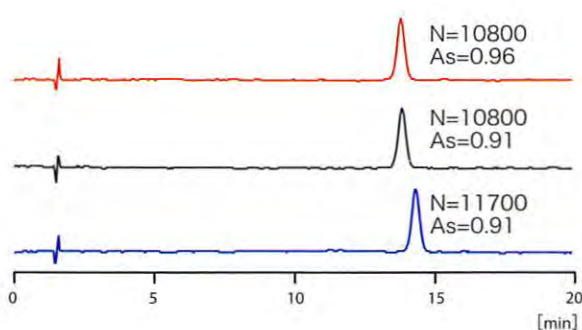
"CAPCELL PAK C<sub>18</sub> MG II" is the solution for analysis of basic compounds under neutral condition



- Advantage 1** → Possible to avoid lowering pH for compounds unstable at acidic conditions.
- Advantage 2** → Beginning a mobile phase optimization at neutral pH makes the process simple, especially in LC-MS.
- Advantage 3** → Good for compounds that show the highest ion intensity at neutral pH in LC-MS.

## Excellent reproducibility

In addition to "Standard of Silica" and "Standards for Parameters of Packing Materials" (both documented by Shiseido), a test with amitriptyline is used to quality-control the production of MG II.



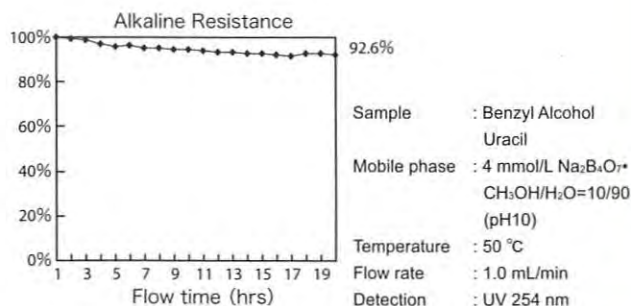
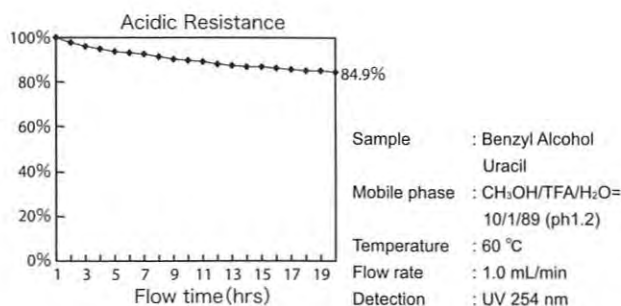
Sample	: Amitriptyline 50 ppm
Injection Vol.	: 5 $\mu$ L
Mobile Phase	: CH <sub>3</sub> OH/20 mmol/L phosphate buffer=75/25
Temperature	: 40 °C
Flow rate	: 1.0 mL/min
Detection	: UV 254 nm

## GLP/GMP Support Column

CAPCELL PAK C<sub>18</sub> MG II, a GLP/GMP support column, is attached with a test chromatogram and a certificate of performance for packing materials used for it. In addition, it is possible to request three columns from three different production lots for a validation purpose.

## Wide pH range from 2 to 10

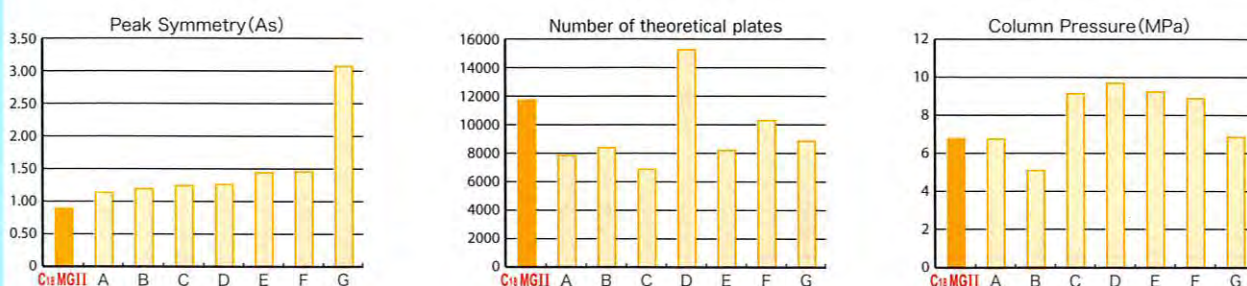
CAPCELL PAK C<sub>18</sub> MG II is a column having excellent performance and durability. The graphs below show the results of the durability test under acidic and basic conditions, indicating that CAPCELL PAK C<sub>18</sub> MG II can be used in a wide pH range.





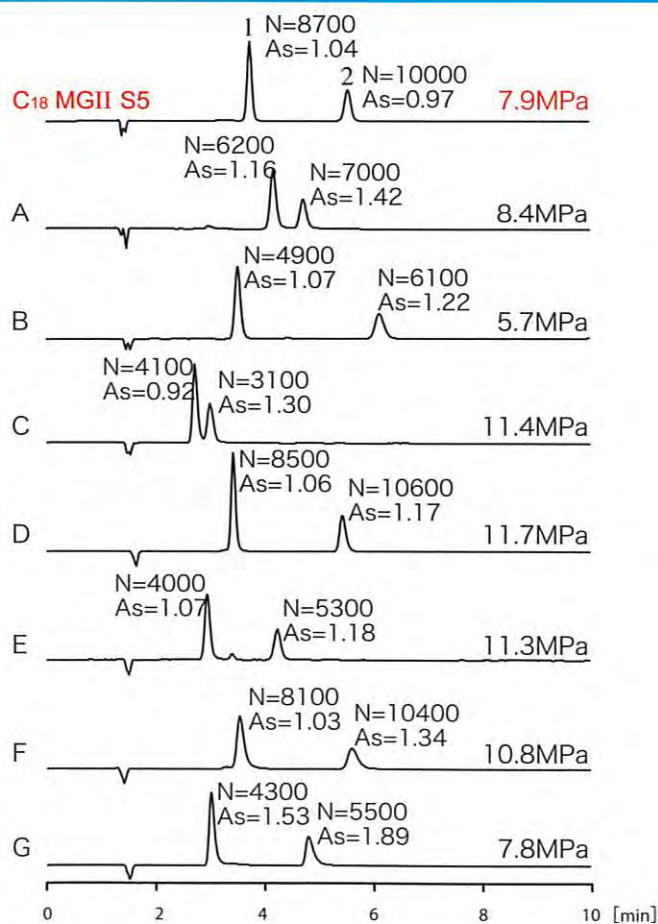
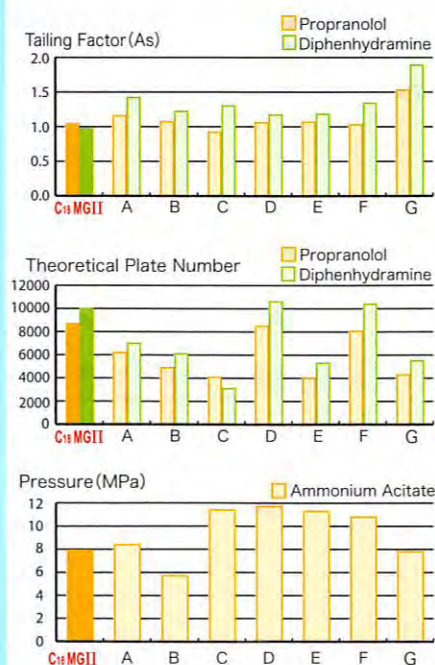
## Shielding silanol groups at the highest level

The graphs below show the comparisons among columns of other suppliers in terms of tailing factor ( $A_s$ ), Number of theoretical plates, and pressure (MPa) of amitriptyline, which are the indicators of the influences of residual silanol.  $A_s$  for MG II, good values were obtained in the three comparative factors. The results indicate that MG II is the best choice for analysis of basic compounds, and has achieved the highest level in shielding silanol groups.



## Analysis using volatile salts

Basic compounds were analyzed with different columns using ammonium acetate, which is a neutral salt often used in LC-MS. Compared with other columns, CAPCELL PAK C<sub>18</sub> MG II showed the top level on peak symmetry and number of theoretical plates. In addition, MG II also showed low column pressure, which is one of the features common to all the CAPCELL PAK columns.

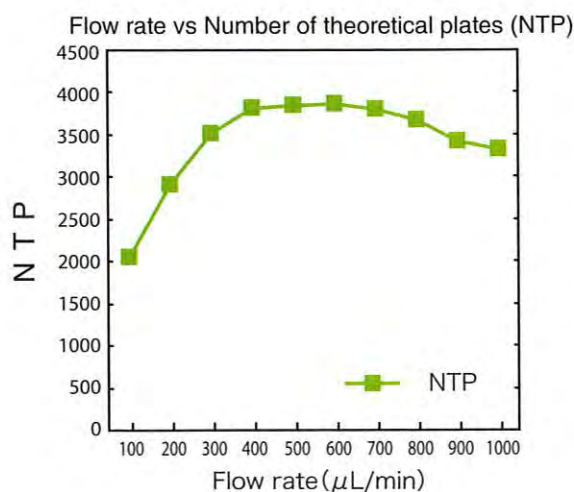


Column size : 4.6 mm i.d. x 150 mm  
 Mobile phase : 10 mmol/L NH<sub>4</sub>AcO, MeOH/H<sub>2</sub>O=60/40, pH 7.35  
 Flow rate : 1.0 mL/min  
 Detection : UV 254 nm  
 Injection Vol. : 5 $\mu$ L  
 Temperature : 40 °C  
 Sample : 1. Propranolol (100 ppm)  
 2. Diphenhydramine (200 ppm)

## 3- $\mu\text{m}$ particles for high-throughput analysis

### CAPCELL PAK C<sub>18</sub> MGII S3 Provides the solution to meet the high-throughput demand.

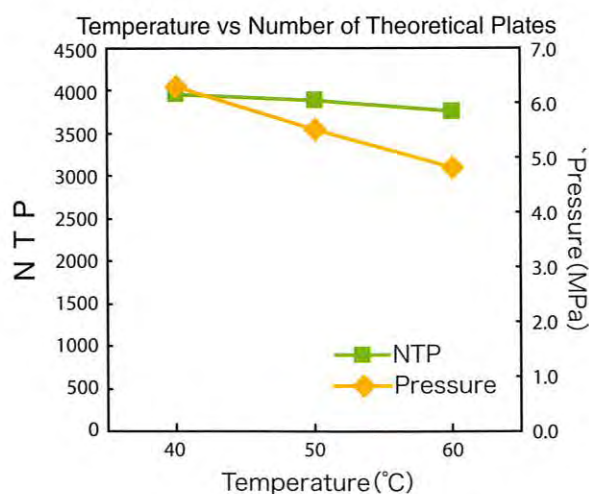
The largest number of theoretical plates is obtained around twice the normal flow rate (200 $\mu\text{L}/\text{min}$  for 2-mm column) and is nearly maintained in the zone of higher flow rates. (Recommended column pressure: 15 MPa or less, Maximum operating pressure: 20 MPa)



Run at more than twice the normal flow rate

- The run time is shortened in inverse proportion to the flow rate!
- Number of theoretical plates increases too!

Sample : Naphthalene  
 Injection Vol. : 5  $\mu\text{L}$   
 Column : C<sub>18</sub> MGII S-3  
 2.0 mm i.d.  $\times$  35 mm  
 Mobile phase : CH<sub>3</sub>CN/H<sub>2</sub>O=50/50  
 Temperature : 40  $^{\circ}\text{C}$   
 Detection : UV 254 nm



Raise the temperature.

- Lowering pressure and increasing number of theoretical plates!

Sample : Naphthalene  
 Injection Vol. : 5  $\mu\text{L}$   
 Column : C<sub>18</sub> MGII S-3  
 2.0 mm i.d.  $\times$  35 mm  
 Mobile phase : CH<sub>3</sub>CN/H<sub>2</sub>O=50/50  
 Flow rate : 400  $\mu\text{L}/\text{min}$   
 Detection : UV 254 nm  
 Temperature : 40 $^{\circ}\text{C}$ , 50 $^{\circ}\text{C}$ , 60 $^{\circ}\text{C}$

## Popular Column Dimension

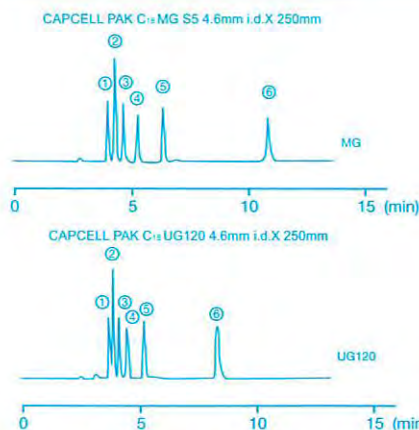
Partial Number	Function Group	Grade	Pore Size (Å)	Particle Size ( $\mu\text{m}$ )	Length (mm)	I.D. (mm)
92469	C <sub>18</sub>	MGII	100	3	100	2.0
92470	C <sub>18</sub>	MGII	100	3	150	2.0
92479	C <sub>18</sub>	MGII	100	3	50	4.6
92480	C <sub>18</sub>	MGII	100	3	75	4.6
92481	C <sub>18</sub>	MGII	100	3	100	4.6
92482	C <sub>18</sub>	MGII	100	3	150	4.6

Partial Number	Group	Grade	Pore Size (Å)	Particle Size ( $\mu\text{m}$ )	Length (mm)	I.D. (mm)
92519	C <sub>18</sub>	MGII	100	5	100	2.0
92520	C <sub>18</sub>	MGII	100	5	150	2.0
92521	C <sub>18</sub>	MGII	100	5	250	2.0
92531	C <sub>18</sub>	MGII	100	5	100	4.6
92532	C <sub>18</sub>	MGII	100	5	150	4.6
92533	C <sub>18</sub>	MGII	100	5	250	4.6

MG stands for Miracle Grade. The enhancement of hydrophobicity had previously been considered to conflict with the enhancement of surface polarity. This miraculous packing material, however, achieved an exquisite balance through the fine control of polymer coating and alkyl group introduction.

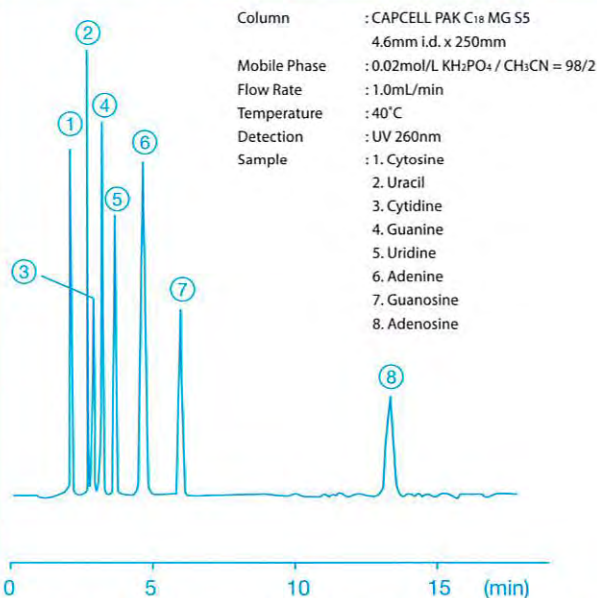
A wide range of compounds (acidic, neutral, and basic compounds, low-polarity to high-polarity compounds, and others) can be efficiently separated. This column is the optimum "first choice", being free of specific selectivity, easy-to-use, available in the pH range 2-10, and extremely durable.

## Organic acids



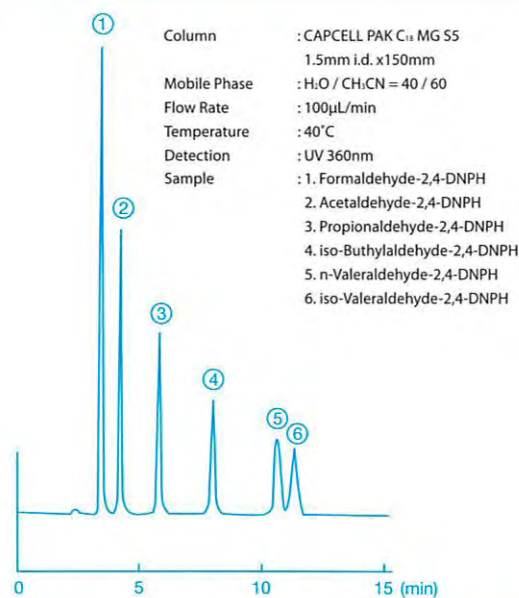
Column	: 4.6mm i.d. x 250mm
Mobile Phase	: 0.1vol% H <sub>3</sub> PO <sub>4</sub> / CH <sub>3</sub> CN = 97.5 / 2.5
Flow Rate	: 1.0mL/min
Temperature	: 40°C
Detection	: UV 210nm
Sample	: 1. Malonic acid 2. Lactic acid 3. Acetic acid 4. Citric acid 5. Succinic acid 6. Propionic acid

## Nucleic acid bases, Nucleosides



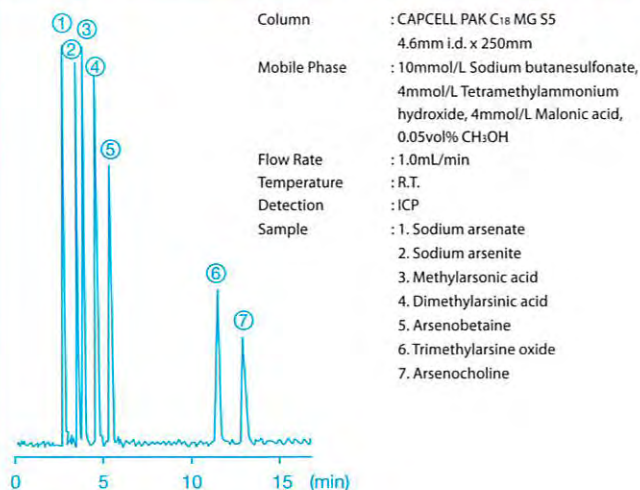
Column	: CAPCELL PAK C <sub>18</sub> MG S5 4.6mm i.d. x 250mm
Mobile Phase	: 0.02mol/L KH <sub>2</sub> PO <sub>4</sub> / CH <sub>3</sub> CN = 98/2
Flow Rate	: 1.0mL/min
Temperature	: 40°C
Detection	: UV 260nm
Sample	: 1. Cytosine 2. Uracil 3. Cytidine 4. Guanine 5. Uridine 6. Adenine 7. Guanosine 8. Adenosine

## DNPH-aldehydes



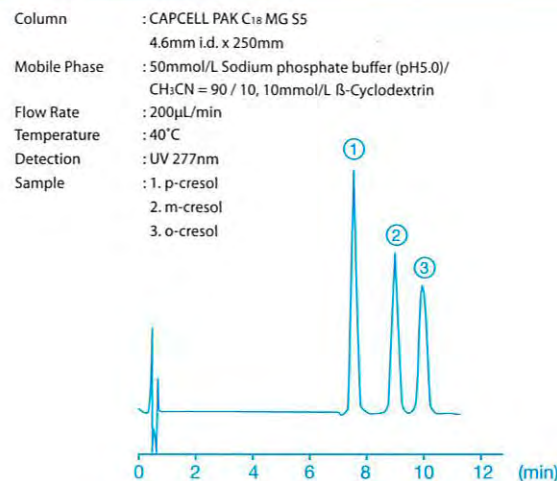
Column	: CAPCELL PAK C <sub>18</sub> MG S5 1.5mm i.d. x 150mm
Mobile Phase	: H <sub>2</sub> O / CH <sub>3</sub> CN = 40 / 60
Flow Rate	: 100µL/min
Temperature	: 40°C
Detection	: UV 360nm
Sample	: 1. Formaldehyde-2,4-DNPH 2. Acetaldehyde-2,4-DNPH 3. Propionaldehyde-2,4-DNPH 4. iso-Butylaldehyde-2,4-DNPH 5. n-Valeraldehyde-2,4-DNPH 6. iso-Valeraldehyde-2,4-DNPH

## Analysis of Arsenic Compounds by LC/ICP



Column	: CAPCELL PAK C <sub>18</sub> MG S5 4.6mm i.d. x 250mm
Mobile Phase	: 10mmol/L Sodium butanesulfonate, 4mmol/L Tetramethylammonium hydroxide, 4mmol/L Malonic acid, 0.05vol% CH <sub>3</sub> OH
Flow Rate	: 1.0mL/min
Temperature	: R.T.
Detection	: ICP
Sample	: 1. Sodium arsenate 2. Sodium arsenite 3. Methylarsonic acid 4. Dimethylarsinic acid 5. Arsenobetaine 6. Trimethylarsine oxide 7. Arsenocholine

## Cresols



Column	: CAPCELL PAK C <sub>18</sub> MG S5 4.6mm i.d. x 250mm
Mobile Phase	: 50mmol/L Sodium phosphate buffer (pH5.0) / CH <sub>3</sub> CN = 90 / 10, 10mmol/L β-Cyclodextrin
Flow Rate	: 200µL/min
Temperature	: 40°C
Detection	: UV 277nm
Sample	: 1. p-cresol 2. m-cresol 3. o-cresol

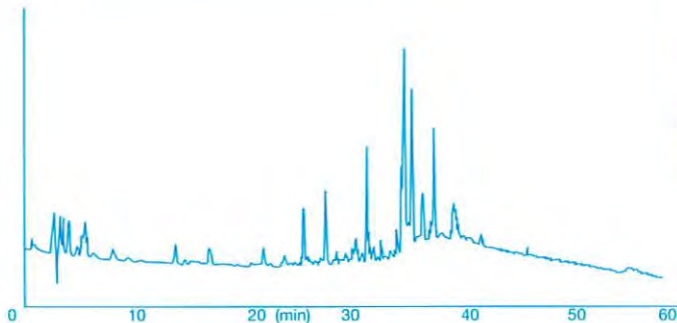
## Capillary Columns

**The MG S5 and S3 are now available in 0.5mm and 0.3mm i.d. !!**

The MG phase is now available in capillary columns to meet the highest sensitivity and resolution, demanded typically in the field of proteomics.

At 150mm length, S5 (5 $\mu$ m) and S3 (3 $\mu$ m) offer NTP (number of theoretical plates) of over 10,000 and 14,000 respectively.

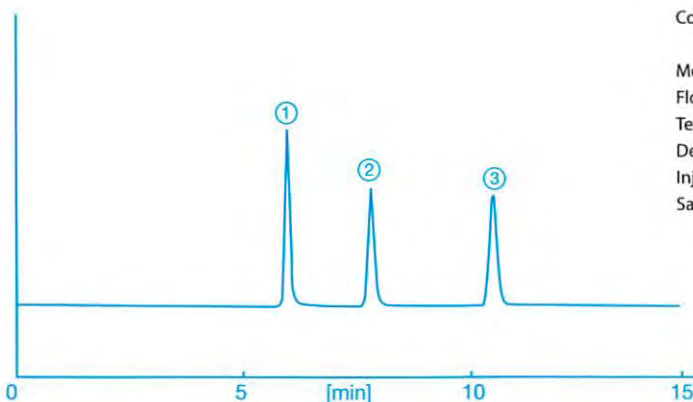
### Peptide Mapping with high Resolution



#### HPLC Conditions

Column	: CAPCELL PAK C <sub>18</sub> MG S3 0.3mm i.d. x 150mm
Mobile phase	: A: 0.05vol% TFA, H <sub>2</sub> O B: 0.05vol% TFA, CH <sub>3</sub> CN B: 10%(0min) → 50%(45min) → 50%(60min)
Flow rate	: 5 $\mu$ L/min
Temperature	: RT
Detection	: UV 210 nm
Injection	: 60nL
Sample	: Tryptic digest of casein

### High NTP and Excellent Peak Symmetry



Column	: CAPCELL PAK C <sub>18</sub> MGS3 0.3mm i.d. x 150mm
Mobile phase	: H <sub>2</sub> O / CH <sub>3</sub> CN= 25 / 75(v/v)
Flow rate	: 5 $\mu$ L/min
Temperature	: RT
Detection	: UV 254nm
Injection	: 60nL
Sample	: 1. Ethyl benzene 2. n-Propyl benzene 3. n-Butyl benzene

### Column Dimension

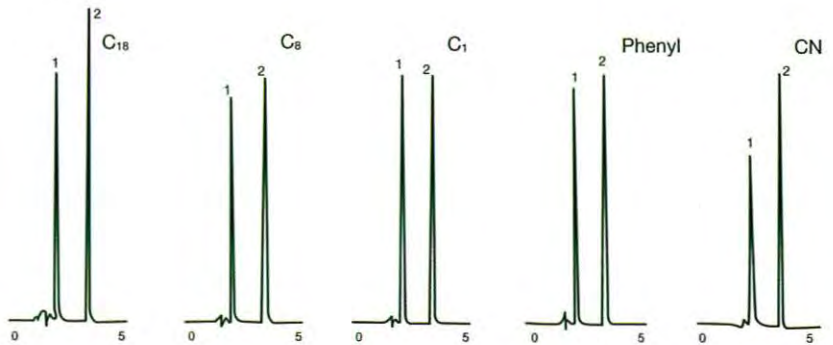
phase	type	size	i.d.(mm)	length (mm)
C <sub>18</sub>	MG	5 $\mu$ m	0.3	150
			0.5	
		3 $\mu$ m	0.3	
			0.5	

The CAPCELL PAK UG type utilizes a high-purity silica with low metal impurity (<5ppm), that gives a fast separation of basic and polar compounds with sharp symmetrical peaks.

### Excellent surface inertness

#### PYRIDINE/PHENOL TEST

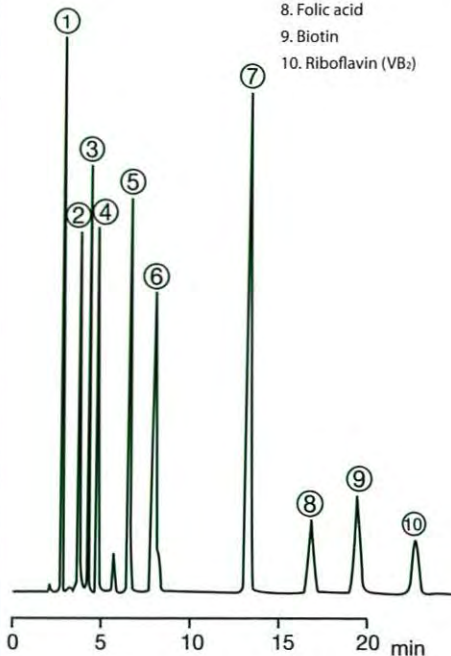
Column : CAPCELL PAK UG120 4.6mm i.d. x 150mm  
 Mobile Phase : CH<sub>3</sub>CN/H<sub>2</sub>O=30/70  
 Flow Rate : 1.0mL/min  
 Temperature : 40°C  
 Detection : UV 254nm  
 Sample : 1.Pyridine  
 2.Phenol



### C<sub>18</sub> UG

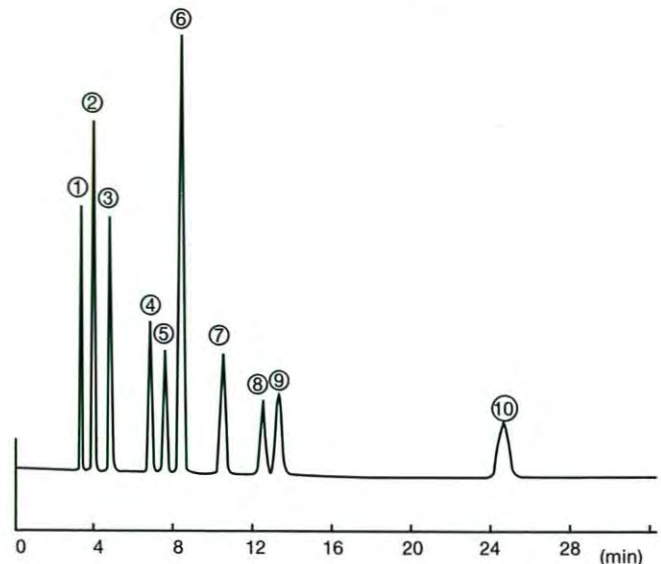
#### Water soluble vitamins

Column : CAPCELL PAK C<sub>18</sub> UG120 S5  
 4.6mm i.d. x 150mm  
 Mobile Phase : (5mmol/L Sodium hexanesulfonate  
 + 20mmol/L H<sub>2</sub>PO<sub>4</sub>, pH2.3) /  
 CH<sub>3</sub>CN = 91 / 9  
 Flow Rate : 1.0mL/min  
 Temperature : 40°C  
 Detection : UV 210nm  
 Sample : 1. L-Ascorbic acid  
 2. Nicotinic acid  
 3. Nicotinamide  
 4. Sodium pantothenate  
 5. Pyridoxine hydrochloride  
 6. Riboflavin phosphate  
 7. Thiamine  
 8. Folic acid  
 9. Biotin  
 10. Riboflavin (VB<sub>2</sub>)



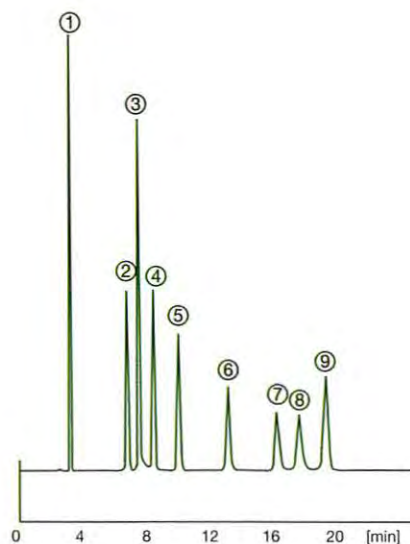
#### Antiseptics

Column : CAPCELL PAK C<sub>18</sub> UG120 S5  
 4.6mm i.d. x 150mm  
 Mobile Phase : 0.05mol/L NaH<sub>2</sub>PO<sub>4</sub>, pH4.5 / MeOH /  
 CH<sub>3</sub>CN = 50 / 35 / 15, 4mmol/L  
 Cetyltrimethyl ammonium chloride  
 Flow Rate : 1.0mL/min  
 Temperature : 40°C  
 Detection : UV 235nm  
 Sample : 1. Methylparaben  
 2. p-Hydroxy benzoic acid  
 3. Ethylparaben  
 4. Dehydroacetic acid  
 5. n-Propylparaben  
 6. Sorbic acid  
 7. Benzoic acid  
 8. Iso-Butylparaben  
 9. n-Butylparaben  
 10. Salicylic acid



## Acidic hair dyes

Column	: CAPCELL PAK C <sub>18</sub> UG120 S5 4.6mm i.d. x 150mm
Mobile Phase	: 50mmol/L Sodium 1-octanesulfonate / CH <sub>3</sub> OH = 60 / 40 (pH2.5, H <sub>3</sub> PO <sub>4</sub> )
Flow Rate	: 1.0mL/min
Temperature	: 40°C
Detection	: UV 280nm
Sample	: 1. Resorcin 2. p-Aminophenol 3. p-Nitro-o-phenylenediamine 4. m-Aminophenol 5. o-Aminophenol 6. m-Phenylenediamine 7. p-Phenylenediamine 8. p-Toluenediaminosulfonate 9. p-Amino-o-cresol



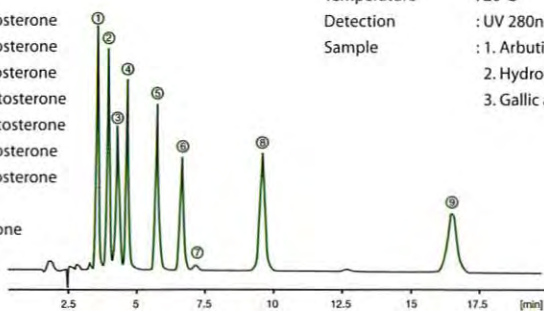
## Ingredients of cold medicines

Column	: CAPCELL PAK C <sub>18</sub> UG120 S5 4.6mm i.d. x 150mm
Mobile Phase	: 0.05mol/L NaH <sub>2</sub> PO <sub>4</sub> / CH <sub>3</sub> CN = 20 / 80 (pH2.5, H <sub>3</sub> PO <sub>4</sub> )
Flow Rate	: 1.0mL/min
Temperature	: 40°C
Detection	: UV 280nm
Sample	: 1. Potassium guaiacolsulfonate 2. Acetaminophen 3. Caffeine 4. Salicylamide 5. Chlorpheniramine maleate 6. Phenol(I.S.) 7. Aspirin 8. Ethenzamide



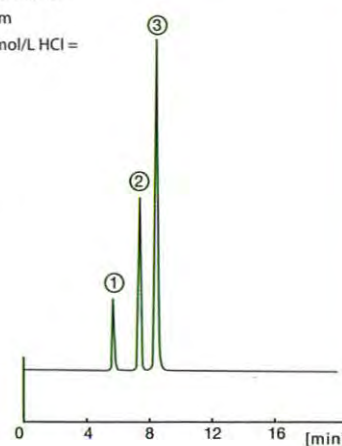
## Metabolites of testosterone

Column	: CAPCELL PAK C <sub>18</sub> UG120 S5 4.6mm i.d. x 150mm
Mobile Phase	: H <sub>2</sub> O / CH <sub>3</sub> OH / THF = 55 / 38 / 7
Flow Rate	: 1.0mL/min
Temperature	: 40°C
Detection	: UV 254nm
Sample	: 1. 6 $\alpha$ -Hydroxytestosterone 2. 7 $\alpha$ -Hydroxytestosterone 3. 6 $\beta$ -Hydroxytestosterone 4. 16 $\alpha$ -Hydroxytestosterone 5. 16 $\beta$ -Hydroxytestosterone 6. 2 $\alpha$ -Hydroxytestosterone 7. 2 $\beta$ -Hydroxytestosterone 8. Androsterone 9. Methyltestosterone



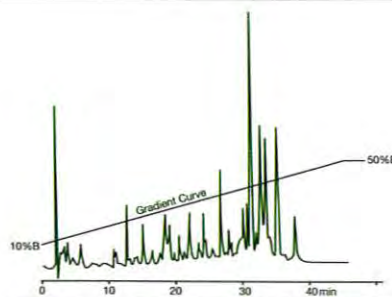
## Active ingredients of bearberry leaf

Column	: CAPCELL PAK C <sub>18</sub> UG120 S5 4.6mm i.d. x 150mm
Mobile Phase	: H <sub>2</sub> O / CH <sub>3</sub> OH / 0.1mol/L HCl = 94 / 5 / 1
Flow Rate	: 0.6mL/min
Temperature	: 20°C
Detection	: UV 280nm
Sample	: 1. Arbutin 2. Hydroquinone 3. Gallic acid



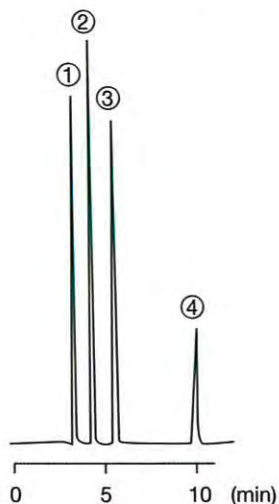
## Tryptic digest of casein (peptide mapping)

Column	: CAPCELL PAK C <sub>18</sub> UG120 S5 1.0 mm i.d. x 250 mm
Mobile Phase	: A : 0.1vol% TFA, H <sub>2</sub> O B : 0.1vol% TFA, CH <sub>3</sub> CN B 10% - 50% (45min) Gradient
Flow Rate	: 70 $\mu$ L/min
Temperature	: 35°C
Detection	: UV 210nm
Sample	: 1. Tryptic digest of casein



**C<sub>8</sub> UG120**

Suitable for quick separation of polar compounds, which used to be retained too long in other C<sub>18</sub> phases.



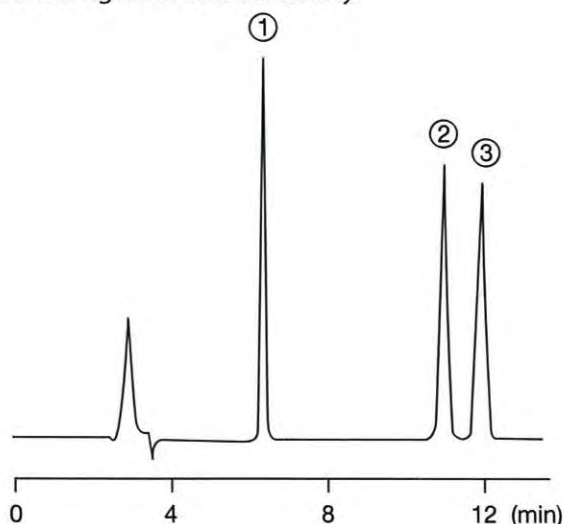
Column	: CAPCELL PAK C <sub>8</sub> UG120 S5 4.6mm i.d. x 150mm
Mobile Phase	: 0.1vol% H <sub>3</sub> PO <sub>4</sub> / CH <sub>3</sub> OH = 70 / 30
Flow Rate	: 1.0mL/min
Temperature	: 40°C
Detection	: UV 254nm
Sample	: 1. Hydroquinone 2. Resorcin 3. Catechol 4. Phenol

**Ph UG120**

Used for obtaining a different selectivity for analytes possessing an aromatic moiety.

**Antiepileptics**

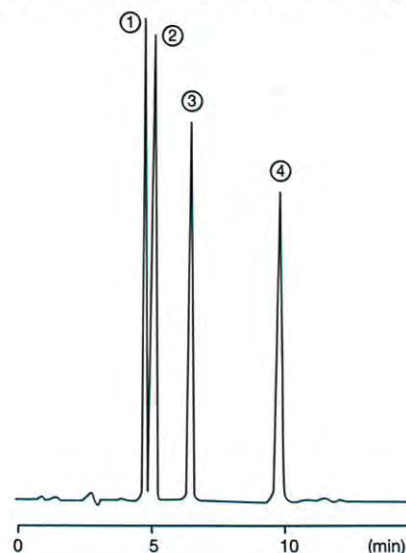
Column	: CAPCELL PAK Ph UG120 S5 4.6mm i.d. x 150mm
Mobile Phase	: { 50mmol/L Na <sub>2</sub> HPO <sub>4</sub> + 50mmol/L KH <sub>2</sub> PO <sub>4</sub> (pH6.8) } / CH <sub>3</sub> CN = 70 / 30
Flow Rate	: 1.0mL/min
Temperature	: 40°C
Detection	: UV 254nm
Sample	: 1. Phenobarbital 2. Carbamazepine 3. Phenytoin

**CN UG120**

A phase having the least retentive nature of all reversed phases and a different selectivity brought by cyano groups.

**Steroids**

Column	: CAPCELL PAK CN UG120 S5 4.6mm i.d. x 150mm
Mobile Phase	: CH <sub>3</sub> CN / H <sub>2</sub> O = 35 / 65
Flow Rate	: 1.0mL/min
Temperature	: 35°C
Detection	: UV 242nm
Sample	: 1. Cortisol 2. Cortisone 3. Corticosterone 4. Testosterone

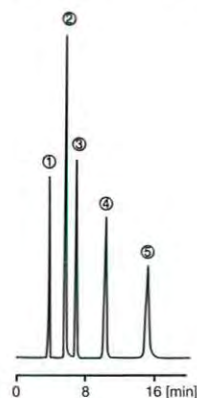


**NH<sub>2</sub> UG80**

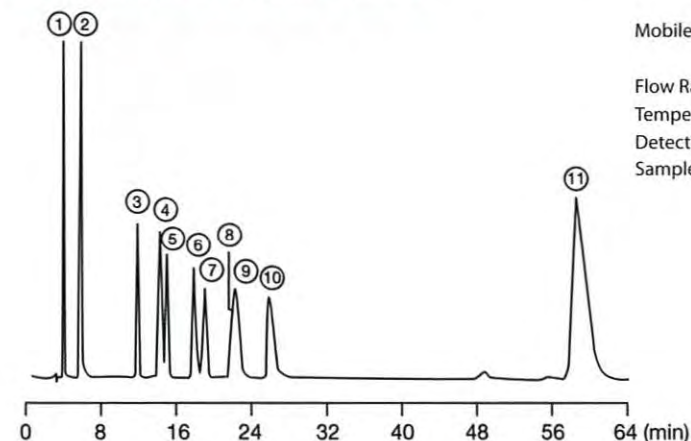
To be used as a normal phase under a water/organic mobile phase, or a weak anion exchanger under an acidic buffer.

**Nucleotides**

Column	: CAPCELL PAK NH <sub>2</sub> UG80 S5 4.6mm i.d. x 250mm
Mobile Phase	: 0.05mol/L (NH <sub>4</sub> ) <sub>2</sub> HPO <sub>4</sub> (pH3.0)
Flow Rate	: 1.0mL/min
Temperature	: 40°C
Detection	: UV 254nm
Sample	: 1. 5'-CMP 2. 5'-AMP 3. 5'-UMP 4. 5'-IMP 5. 5'-GMP

**SCX UG80**

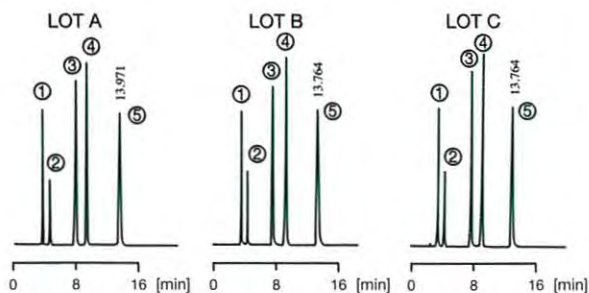
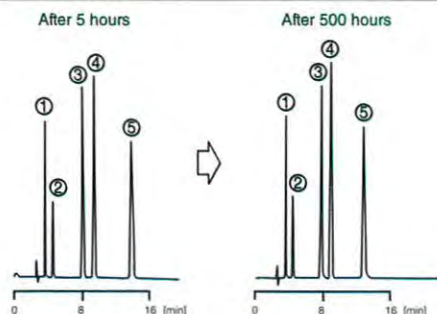
A strong cation exchanger used for basic compounds.

**Determination of biogenic amines**

Column	: CAPCELL PAK SCX UG80 4.6mm i.d. x 150mm
Mobile Phase	: 0.2mol/L CH <sub>3</sub> COONa + 0.02mol/L CH <sub>3</sub> COOH (pH5.6)
Flow Rate	: 1.0mL/min
Temperature	: 40°C
Detection	: UV 254nm
Sample	: 1. Dopa 2. Creatinine 3. Norepinephrine 4. Epinephrine 5. Octopamine 6. Normetanephrine 7. Dopamine 8. Isoproterenol 9. Metanephrine 10. Tyramine 11. Serotonin

**Excellent lot-to-lot reproducibility**

Column	: CAPCELL PAK SCX UG80 4.6mm i.d. x 150mm
Mobile Phase	: 0.2mol/L NH <sub>4</sub> H <sub>2</sub> PO <sub>4</sub> (pH3.5)
Flow Rate	: 1.0mL/min
Temperature	: 40°C
Detection	: UV 254nm
Sample	: 1. Uracil 2. Thymine 3. Guanine 4. Cytosine 5. Adenine

**Highly durable**

Column	: CAPCELL PAK SCX UG80 4.6mm i.d. x 150mm
Mobile Phase	: 0.2mol/L NH <sub>4</sub> H <sub>2</sub> PO <sub>4</sub> (pH3.5)
Flow Rate	: 1.0mL/min
Temperature	: 40°C
Detection	: UV 254nm
Sample	: 1. Uracil 2. Thymine 3. Guanine 4. Cytosine 5. Adenine

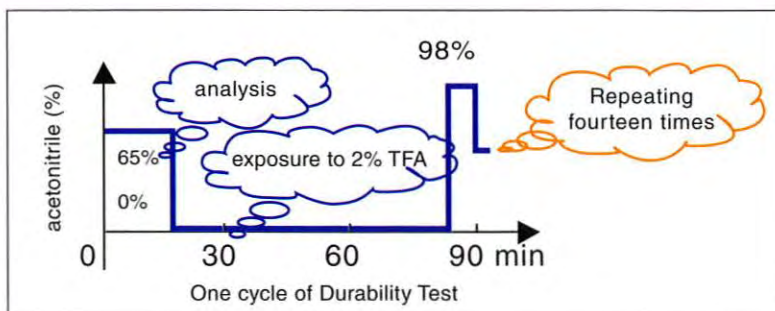


# CAPCELL PAK C<sub>18</sub> ACR

**CAPCELL PAK C<sub>18</sub> ACR** was synthesized through a modified polymer-coating technique, and intended to show an outstanding durability under an acidic mobile phase. Its performance was proven in the evaluation method originally designed for acidic resistance.

\* ACR Capillary Columns are also available

## Acidic resistance test

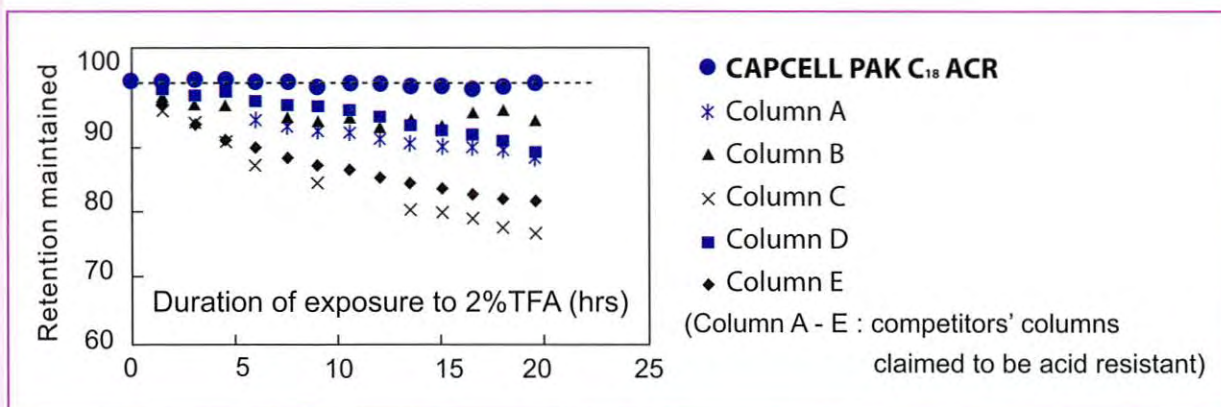


### HPLC conditions

Column : C<sub>18</sub> ACR 4.6mm i.d.x150mm  
 Mobile phase : A: 2vol% TFA in H<sub>2</sub>O (pH1)  
 : B: 2vol% TFA in CH<sub>3</sub>CN  
 : B: 65%(20min) - 0%(60min) - 98%(5min) - 65%(5min)  
 Flow rate : 1.0mL/min  
 Temperature : 60°C  
 Detection : UV 254 nm  
 Injection : 7μL  
 Sample : uracil, amylbenzene



## Comparison of Acidic Resistance



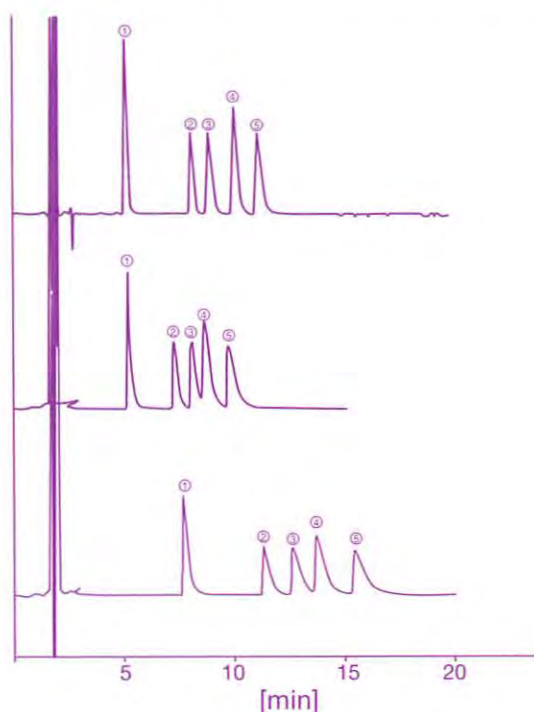
## CAPCELL PAK C<sub>18</sub> ACR compared to other CAPCELL PAK C<sub>18</sub> phases

Type	Surface Area m <sup>2</sup> /g	Pore Volume mL/g	Pore Size nm	Particle Diameter μm	Carbon Content %
ACR	340	0.8	8	5	18
MG	260	0.9	10	5	15
UG120	300	1.0	12	5	15
UG80	340	0.8	8	5	18

## ACR Applications

### Basic Compounds...Tricyclic antidepressants

Peaks of tricyclic antidepressants, highly basic compounds, are known to be easily affected by residual silanols of a stationary phase. The tendency is pronouncing under acidic mobile phases commonly used in LC-MS. The following comparison is performed between CAPCELL PAK C<sub>18</sub> ACR and Column F, one of the major commercial columns, using five typical antidepressants. The ACR column shows a good baseline separation for these compounds, while Column F shows a very unstable retention behavior, influenced by a slight change in organic content in a mobile phase. The inertness of the ACR column was explained by its completely polymer-coated surface structure.



#### (HPLC Conditions)

Column Size	: 4.6mm i.d.x150mm
Flow Rate	: 1.0mL/min
Temperature	: 40°C
Detection	: UV 210nm
Samples	① Doxepine ② Desipramine ③ Imipramine ④ Nortriptyline ⑤ Amitriptyline

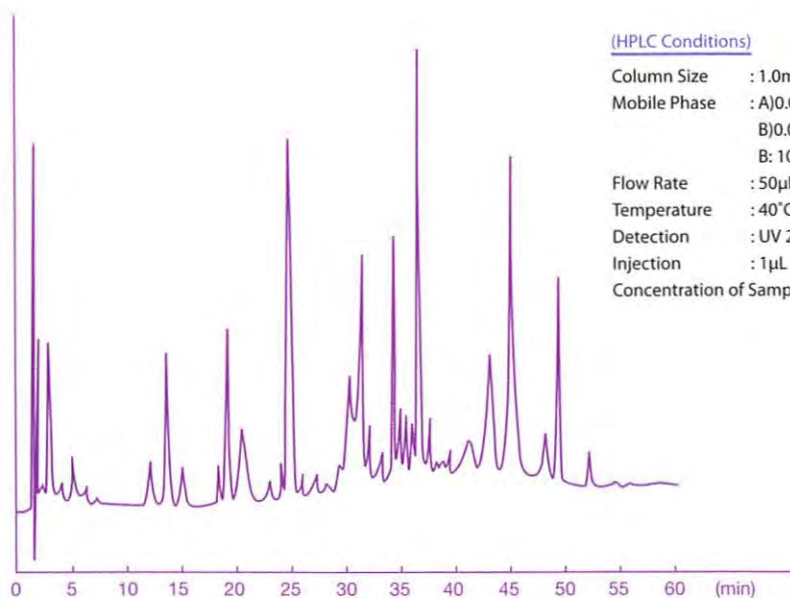
CAPCELL PAK C<sub>18</sub> ACR  
Mobile Phase  
0.1vol% HCOOH, CH<sub>3</sub>CN / H<sub>2</sub>O = 25 / 75

Column F  
Mobile Phase  
0.1vol% HCOOH, CH<sub>3</sub>CN / H<sub>2</sub>O = 33 / 67

Column F  
Mobile Phase  
0.1vol% HCOOH, CH<sub>3</sub>CN / H<sub>2</sub>O = 32 / 68

## Peptide Mapping

### Tryptic digest of fetuin

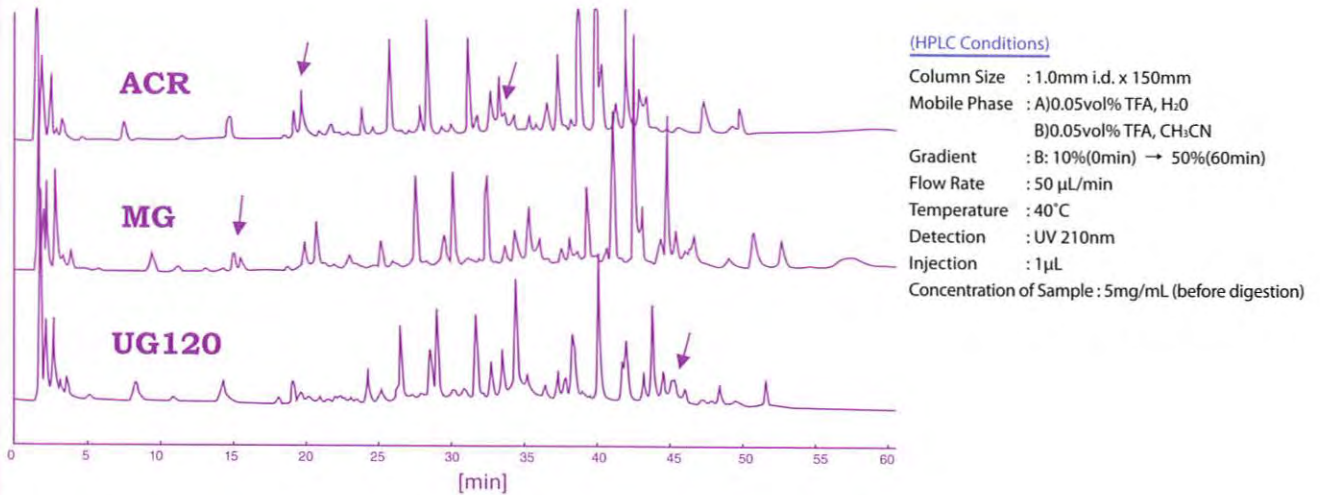


#### (HPLC Conditions)

Column Size	: 1.0mm i.d. x 150mm
Mobile Phase	A) 0.05%vol TFA, H <sub>2</sub> O B) 0.05%vol TFA, CH <sub>3</sub> CN B: 10%(0min) → 50%(60min)
Flow Rate	: 50μL/min
Temperature	: 40°C
Detection	: UV 210nm
Injection	: 1μL
Concentration of Sample	: 7.5mg/mL (before digestion)

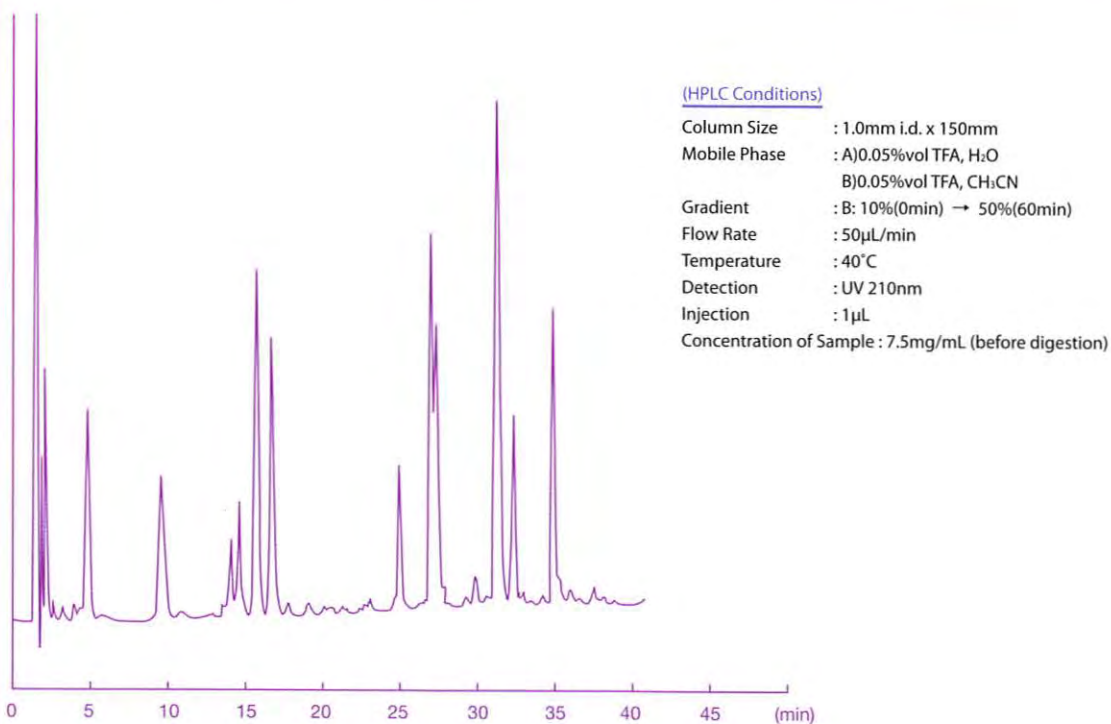
## Tryptic digest of casein

Profiles of tryptic digest of casein obtained with **CAPCELL PAK ACR, MG, and UG120** are compared as shown below. Acidic mobile phases are commonly used in peptide mapping based on reversed-phase chromatography.



Some selectivity differences (indicated with arrows) were observed among these columns.

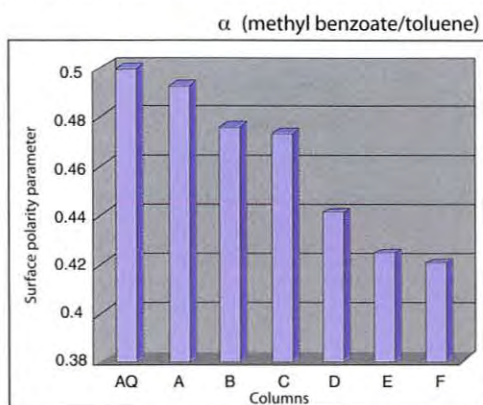
## Tryptic digest of cytochrome C





**CAPCELL PAK C<sub>18</sub> AQ** was intended for separating highly polar compounds under water (buffer) rich mobile phase. Its C<sub>18</sub> group density was designed to be small, and shows a relatively small carbon content. The surface excess of organic solvent molecules on the stationary phase is adequately limited, and a stable retention of analytes can be obtained even under an aqueous mobile phase.

Surface polarity parameter of typical reversed-phase C<sub>18</sub> columns

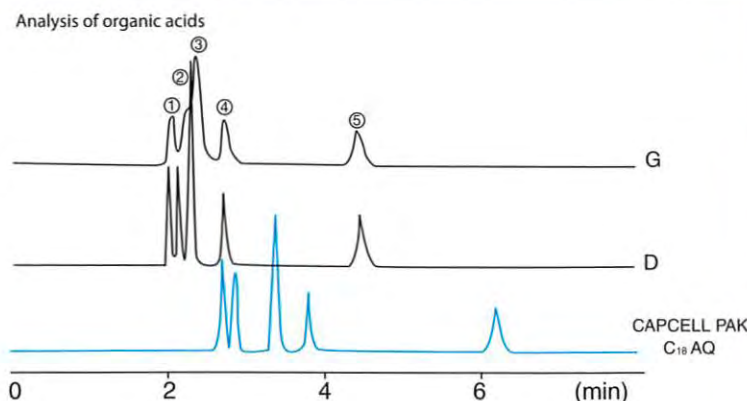


characteristics

Column	Specific surface area of silica support (m <sup>2</sup> /g)	Carbon content (C%)
CAPCELL PAK C <sub>18</sub> AQ	300	11
CAPCELL PAK C <sub>18</sub> MG	260	15
CAPCELL PAK C <sub>18</sub> UG	300	15

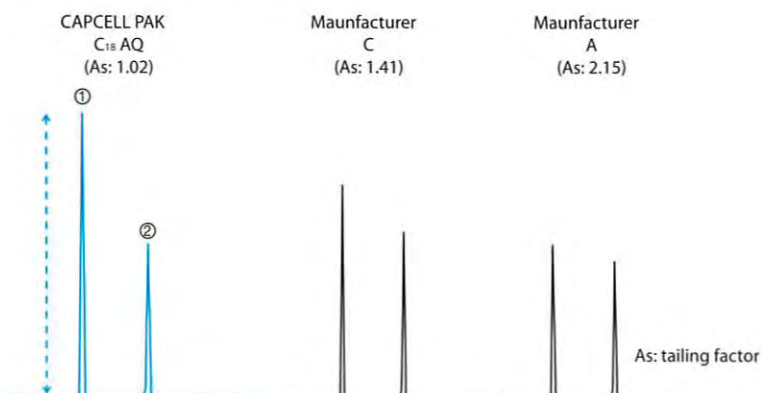
## Excellent retention of polar compounds

- Column : 4.6mm i.d. x 150 mm
- Mobile Phase : 0.1vol% H<sub>3</sub>PO<sub>4</sub>  
CH<sub>3</sub>CN / H<sub>2</sub>O = 2 / 98
- Flow Rate : 1.0 mL/min
- Temperature : 40°C
- Detection : UV 210 nm
- Samples : 1) Lactic acid 2) Acetic acid  
3) Citric acid 4) Succinic acid  
5) Propionic acid



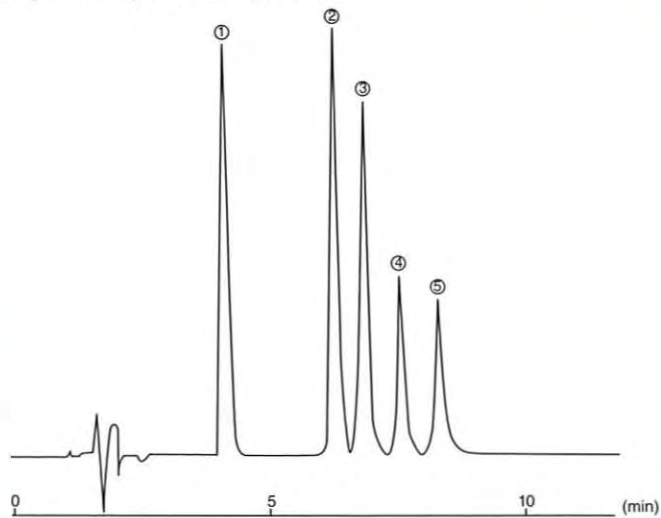
## The peak shape of basic compounds represented by pyridine is almost symmetrical without tailing.

- Column : 4.6mm i.d. x 150 mm
- Mobile Phase : CH<sub>3</sub>CN / H<sub>2</sub>O = 30 / 70
- Flow Rate : 1.0 mL/min
- Temperature : 40°C
- Detection : UV 254 nm
- Samples : 1) Pyridine  
2) Phenol



## Good peak shape of basic compounds under slightly acidic conditions.

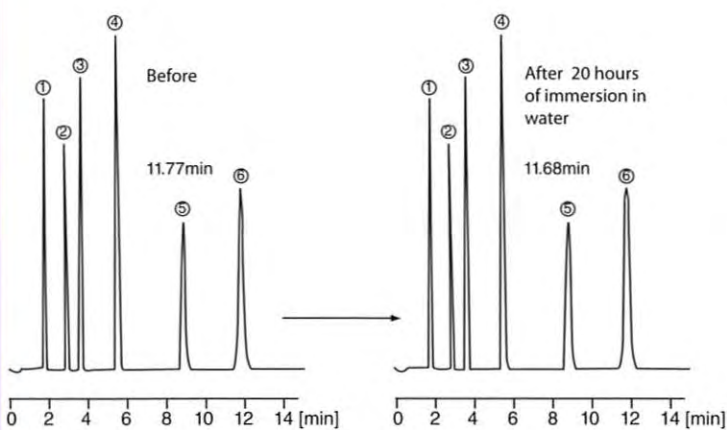
Analysis of tricyclic antidepressants



Column : 4.6mm i.d. x 150 mm  
 Mobile phase : 0.1vol% HCOOH,  
 CH<sub>3</sub>CN /H<sub>2</sub>O = 25 / 75  
 Flow Rate : 1.0 mL/min  
 Temperature : 40°C  
 Detection : UV 210 nm  
 Samples : 1) Doxepine                      4) Nortriptyline  
               2) Desipramine                5) Amitriptyline  
               3) Imipramine

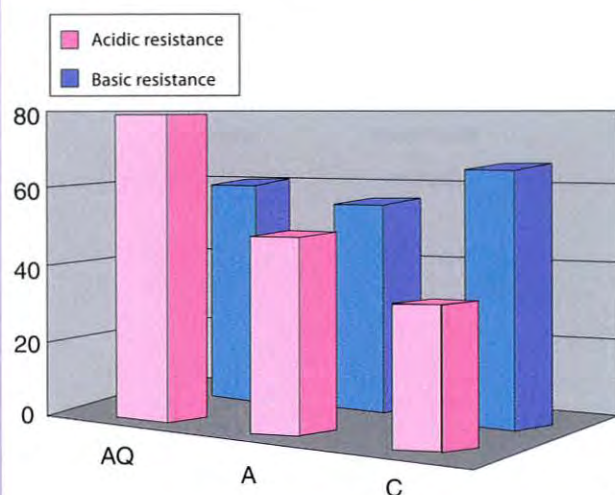
## Compatible with a mobile phase of 100% water

Analysis of nucleic acid base

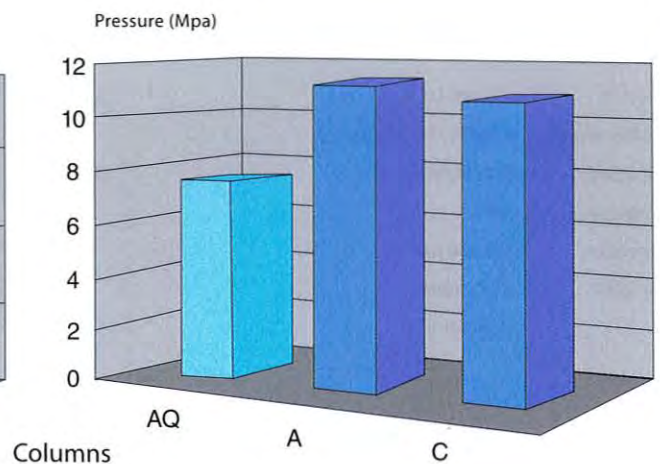


Column : 4.6 mm i.d. x 150 mm  
 Mobile phase : 20 mmol/L KH<sub>2</sub>PO<sub>4</sub>,  
 20 mmol/L K<sub>2</sub>HPO<sub>4</sub>  
 Flow rate : 1.0 mL/min  
 Temperature : 40°C  
 Detection : UV 254 nm  
 Samples : 1) Sodium nitrite            4) Guanine  
               2) Cytosine                    5) Thymine  
               3) Uracil                        6) Adenine

## Superior resistance to acidic and Basic conditions



## Excellent durability due to low column pressure



## CR...Strong Cation Exchange & Reversed Phase

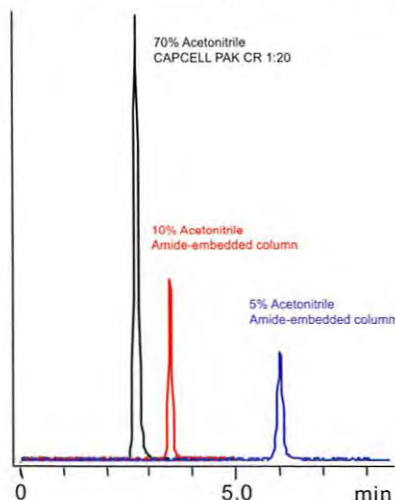
As a method to improve the sensitivity of basic drugs and their metabolites in LC-MS, Shiseido has developed a unique stationary phase.

The new product, "CAPCELL PAK CR," is a single column in which SCX and  $C_{18}$  are mixed inside. The CR column is available with different mixing ratios that were not possible to obtain by connecting two columns; SCX: $C_{18}$  = 1:50, 1:20 and 1:4. Simply choose the optimum column that best suits your separation.

They are intended to elute basic compounds possessing a certain level of hydrophobicity under a mobile phase with a higher organic content than that for  $C_{18}$  phases, for obtaining a higher sensitivity in LC-MS, or simply to obtain an altered separation selectivity.

## Sensitivity increase in LC-MS

When a very hydrophilic and basic compound is to be analyzed in LC-MS, the choice of mobile phase may not be straightforward. An acidity and a large organic content are preferred to obtain a good ionization efficiency (sensitivity), while an organic content is limited in order to keep an adequate retention on reversed phase. CAPCELL PAK CR makes it possible to use a large organic content in a mobile phase for hydrophilic compounds, such as procaine, while only a very small organic content is allowed even for an amide-embedded column, a column considered suitable for such polar compounds.

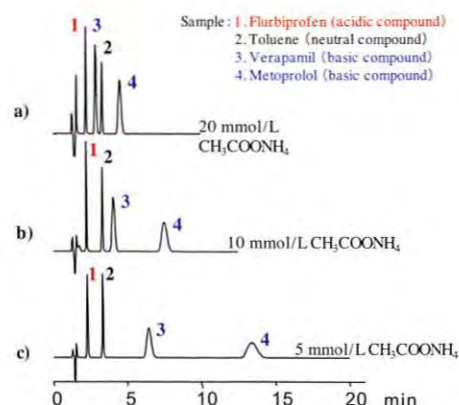


### Conditions

Column	: Black : CAPCELL PAK CR 1 : 20 2.0 mm i.d. x 150 mm Red and blue : Amide-embedded column 2.1 mm i.d. x 150 mm
Mobile phase	: A) 10 mmol/L $\text{HCOONH}_4$ (adjusted at pH3 with $\text{HCOOH}$ ) B) $\text{CH}_3\text{CN}$ A / B : Black 30 / 70, Red 90 / 10, Blue 95 / 5
Flow rate	: 200 $\mu\text{L}/\text{min}$
Temp.	: 40 $^\circ\text{C}$
Detection	: MS, ESI, Positive mode
Inj. vol.	: 2 $\mu\text{L}$
Sample	: Procaine

## Simultaneous analysis of acidic/neutral/basic materials

CAPCELL PAK CR allows the analysis of not only basic compounds but the simultaneous analysis of neutral and acidic compounds. By varying the salt concentration in the mobile phase, it is also possible to independently adjust the retention of the basic compound.

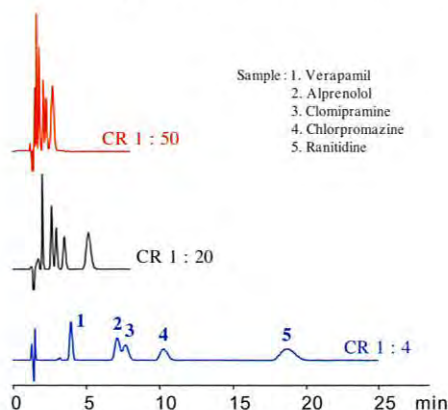


### Conditions

Column	: CAPCELL PAK CR 1 : 4
Column size	: 2.0 mm i.d. x 150 mm
Mobile phase	: a) 20 mmol/L $\text{CH}_3\text{COONH}_4$ (adjusted at pH4.0 with $\text{CH}_3\text{COOH}$ ) / $\text{CH}_3\text{CN}$ = 30 / 70 b) 10 mmol/L $\text{CH}_3\text{COONH}_4$ (adjusted at pH4.0 with $\text{CH}_3\text{COOH}$ ) / $\text{CH}_3\text{CN}$ = 30 / 70 c) 5 mmol/L $\text{CH}_3\text{COONH}_4$ (adjusted at pH4.0 with $\text{CH}_3\text{COOH}$ ) / $\text{CH}_3\text{CN}$ = 30 / 70
Flow rate	: 200 $\mu\text{L}/\text{min}$
Temp.	: 40 $^\circ\text{C}$
Detection	: UV 220 nm
Inj. vol.	: 1 $\mu\text{L}$

## Choice of three different ratios

Reducing run time and improving the separation profile are possible with the same mobile phase condition by choosing a different mixing ratios available in CAPCELL PAK CR.

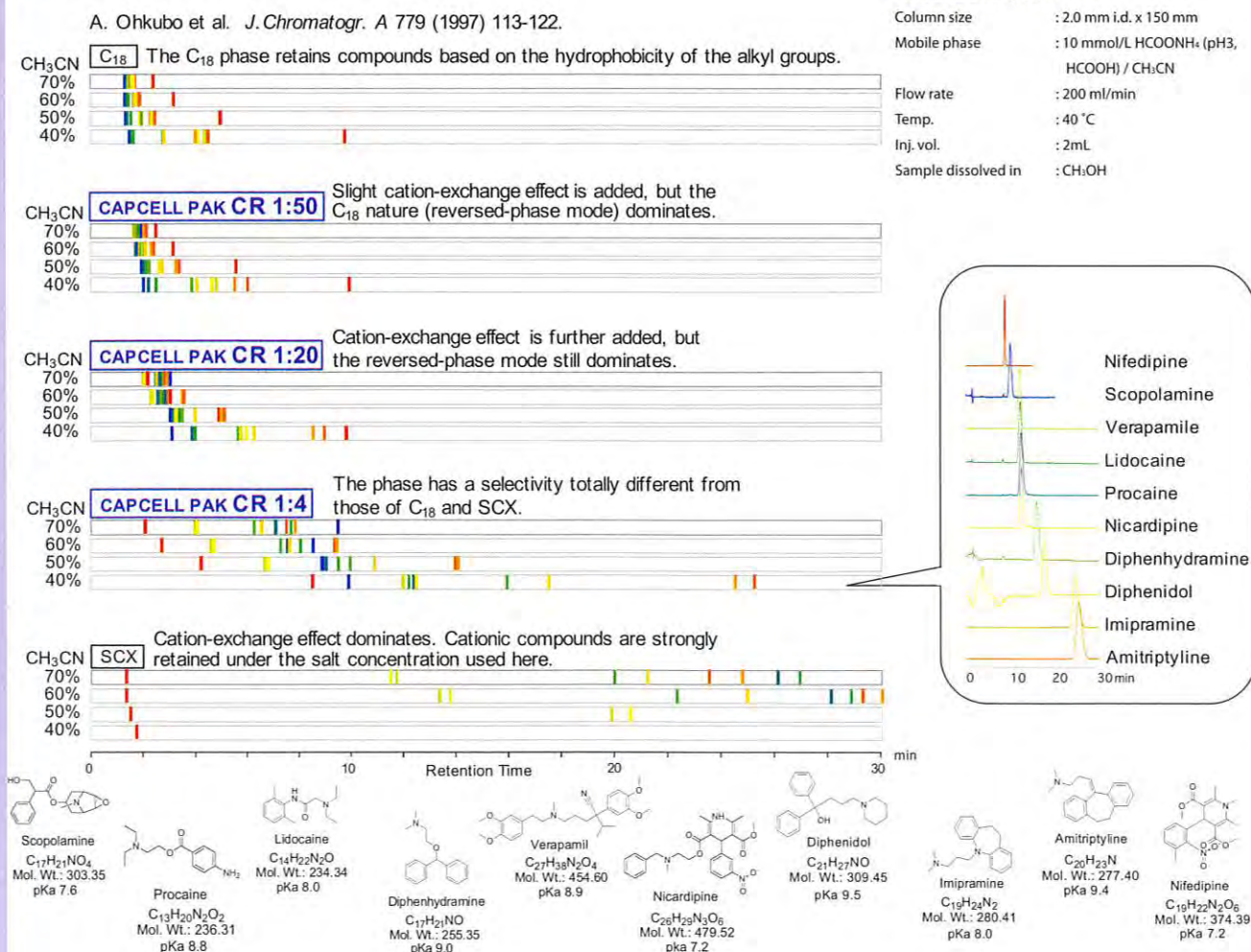


### Conditions

Column	: Red : CAPCELL PAK CR 1 : 50 Black : CAPCELL PAK CR 1 : 20 Blue : CAPCELL PAK CR 1 : 4
Column size	: 2.0 mm i.d. x 150 mm
Mobile phase	: 10 mmol/L HCOONH <sub>4</sub> (adjusted at pH 3.0 with HCOOH) / CH <sub>3</sub> CN = 30 / 70
Flow rate	: 200 μL/min
Temp.	: 40 °C
Detection	: UV 220 nm
Inj. vol.	: 2 μL
Sample	: Basic compounds 5 types

## CAPCELL PAK CR -Atlas-

CAPCELL PAK C<sub>18</sub>, CAPCELL PAK SCX, and three types of CAPCELL PAK CR columns were compared in the separations of ten typical basic compounds. The figures below show structure, pKa value, and change in retention time and selectivity under different mobile phases, for each compound. While CR 1:50 and CR 1:20 generally show selectivity close to those of C<sub>18</sub>, CR 1:4 has selectivity totally different from those of C<sub>18</sub> and SCX. It is advised to utilize the results for method developments of other basic compounds.



# CAPCELL PAK C<sub>8</sub> DD (Double Durability)

30



## CAPCELL PAK C<sub>8</sub> DD, Different performances from those of conventional C<sub>8</sub> phases

Alkyl groups attached to silica-based packing material are cleaved when used in an acidic mobile phase for a long period of time. When used in a basic mobile phase, the silica support dissolves thus destroying the column. Durability of reversed phases has a tendency to decrease as the length of the alkyl group decreases. CAPCELL PAK C<sub>8</sub> DD (Double Durability) is a column with unparalleled acidic and basic resistance. The high surface polarity and smaller hydrophobicity, compared to C<sub>18</sub> columns, make this product the best choice for short-time analysis of mixtures with diverse hydrophobicities.

## Excellent durability (pH range : 1.5 – 10)

### Excellent Acidic resistance

Acidic resistance depends on the concentration of the organic content in a mobile phase. It is known that the higher the concentration of the organic content is, the more difficult it is to cleave the Si-C bond. The test method here uses a mobile phase of pH 1 with no organic solvent, thus representing an extremely harsh acidic condition.

#### \*Acidic resistance test conditions

Mobile phase	: (A) 2 vol% TFA, H <sub>2</sub> O, pH1 (B) 2 vol% TFA, CH <sub>3</sub> CN B 65% (20min)>0% (60min) >98% (5min)>65% (5min)
Flow rate	: 1.0 mL/min
Temperature	: 60 °C
Detection	: UV 254 nm
Sample	: Uracil, amylbenzene

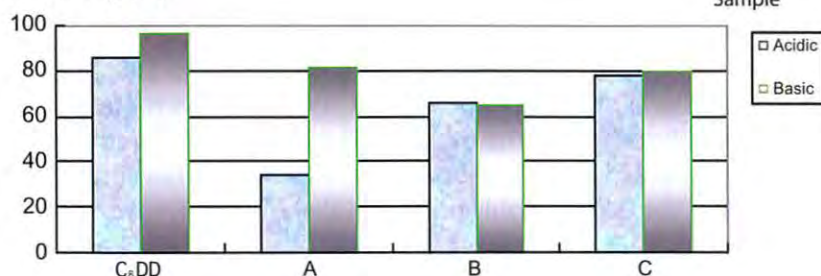
### Excellent Basic resistance

Silica is not hydrolysed under acidic conditions, but unstable under neutral to basic conditions. The test method uses a mobile phase of pH 10 which represents an extremely harsh basic condition.

#### \*Basic resistance test conditions

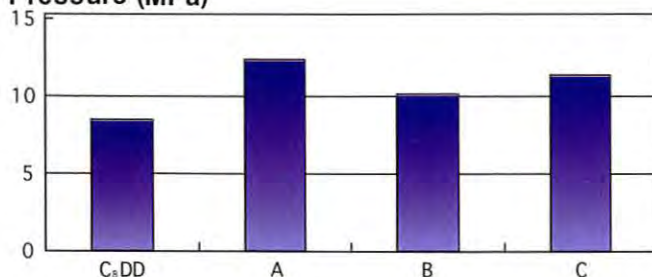
Column	: 4.6mm i.d. x150mm
Mobile phase	: 4 mmol/L Na <sub>2</sub> B <sub>4</sub> O <sub>7</sub> /CH <sub>3</sub> CN=90/10, pH 10.0
Flow rate	: 1.0 mL/min
Temperature	: 50 °C
Detection	: UV 254 nm
Sample	: Uracil, amylbenzene

Durability (%)



## Low back pressure

Pressure (MPa)



#### Conditions

Column	: 4.6mm i.d. x150mm
Mobile phase	: H <sub>2</sub> O/CH <sub>3</sub> CN=50/50
Flow rate	: 1.0 mL/min
Temperature	: 40°C



## Excellent peak shape of basic compounds

The polymer coating technology used for CAPCELL PAK C<sub>8</sub> DD resulted in showing excellent peak shapes for basic compounds. The figure down on the left is the comparison with other columns in "pyridine/phenol test", an evaluation method commonly used for silanol effects. A good separation was also obtained for five tricyclic antidepressants, highly basic compounds (down, left).

### Pyridine/phenol test

As: 1.02



As: 1.57



As: 1.36



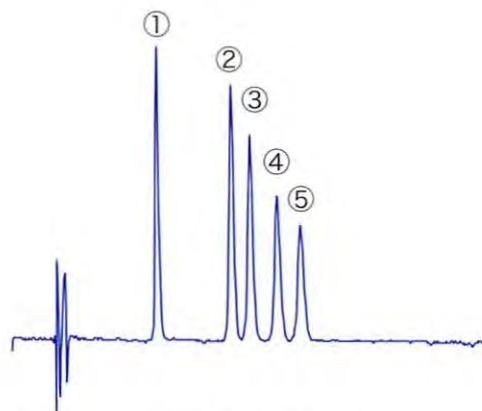
As: 2.61



Condition

Column : Capcell Pak C<sub>8</sub> DD S5  
4.6 mm i.d. x150mm  
Mobile phase : H<sub>2</sub>O/CH<sub>3</sub>CN=30/70  
Flow rate : 1.0 mL/min  
Temperature : 40 °C  
Samples : 1) Pyridine 2) Phenol

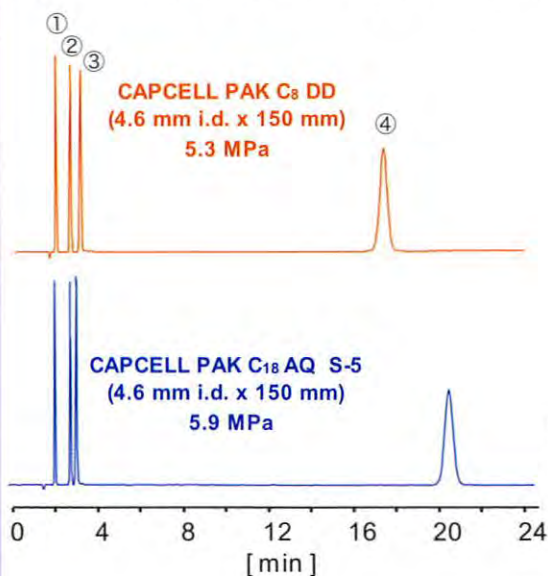
### Analysis of tricyclic antidepressants



Column : Capcell Pak C<sub>8</sub> DD S5  
4.6 mm i.d. x150mm  
Mobile phase : 0.1 vol% HCOOH,  
CH<sub>3</sub>CN/H<sub>2</sub>O=25/75  
Flow rate : 1.0 mL/min  
Temperature : 40 °C  
Detection : UV 254 nm  
Samples : 1) Doxepine 2) Desipramine  
3) Imipramine 4) Nortriptyline  
5) Amitriptyline

## Suitable for quickly separating mixtures with diverse hydrophobicity

This is a comparison between CAPCELL PAK C<sub>18</sub> AQ, and CAPCELL PAK C<sub>8</sub> DD column. Due to large hydrophobicity corresponding to the long functional group, CAPCELL PAK C<sub>18</sub> AQ requires more time to elute ibuprofen that has a relatively high hydrophobicity. On the other hand, C<sub>8</sub> DD column, with its low hydrophobicity, is capable of separating the sample in a much shorter time. In addition, because of the high surface polarity that is equivalent to that of the C<sub>18</sub> AQ, highly polar samples are effectively retained.



Mobile phase : CH<sub>3</sub>OH/H<sub>2</sub>O = 60/40, 0.1 H<sub>3</sub>PO<sub>4</sub>  
Flow rate : 1.0 mL/min  
Detection : UV 220 nm  
Temperature : 40 °C

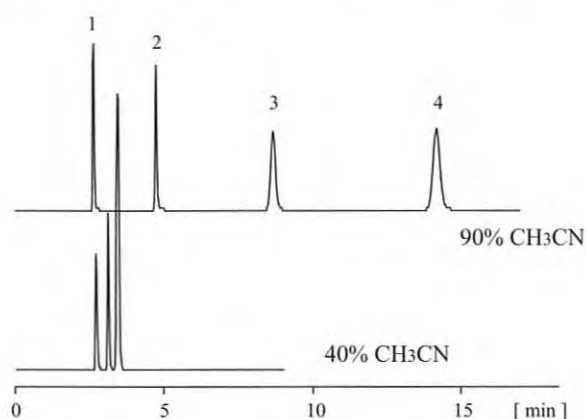
## Features

- A silica-based HILIC column with phosphorylcholine (PC) group
- Excellent retention and separation of very polar and hydrophilic compounds
- Large number of theoretical plates and outstanding peak profiles

PC HILIC is a silica-based HILIC column with phosphorylcholine (PC) group. The superhydrophilic character of PC was taken advantage of in preparing an optimum stationary phase for HILIC mode separation. Polar, hydrophilic, and charged compounds, which are hard to handle in reversed-phase mode, are expected to show adequate retention with PC HILIC.

## What is HILIC?

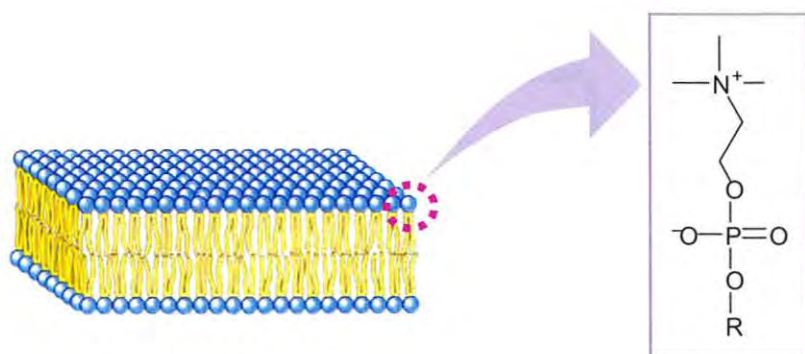
Hydrophilic interaction liquid chromatography (HILIC) is a relatively new LC technique that uses a hydrophilic stationary phase, in most cases, with organic-dominant mobile phase. The elution order of substances in HILIC mode is roughly the reverse of that in reversed-phase mode.



Column	: PC HILIC 4.6 x 250 mm, 5 $\mu$ m
M. phase	: 10mmol/L HCOONH <sub>4</sub> , x% CH <sub>3</sub> CN
Flow rate	: 1 mL/min
Temp.	: 40 °C
Detection	: UV 254 nm
Sample	: 1. Naphthalene, 2. Thymine, 3. Adenine, 4. Cytosine

## What is PC?

Phosphorylcholine (PC) is a partial structure of phosphatidylcholine (lecitin), one of the phospholipids forming cell membranes. PC has a betaine structure and shows high hydrophilicity, biocompatibility, and inhibitory effect of protein adhesion. Its superhydrophilic character is suitable to the application as a HILIC phase.

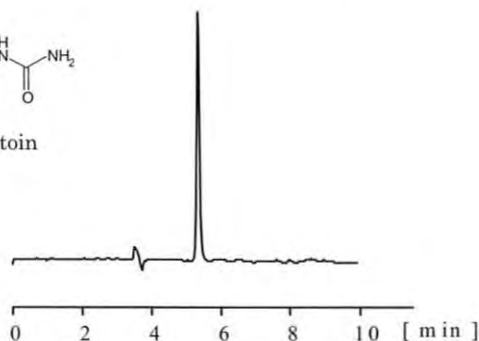
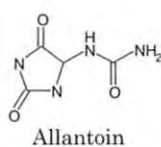


Cell Membrane

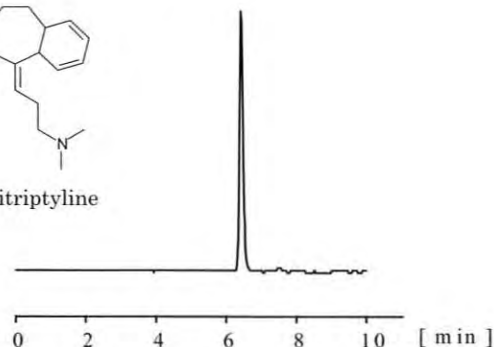
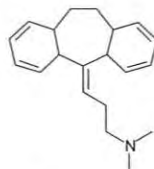
Phosphorylcholine (PC)

## Strong retention of polar compounds

HILIC mode provides another alternative to handle extremely polar and hydrophilic compounds, which are unretainable in reversed-phase (e.g. a chromatogram of allantoin, shown below)



Column : PC HILIC 4.6 x 250 mm, 5 $\mu$ m  
 M. phase : 80% CH<sub>3</sub>CN  
 Flow rate : 1 mL/min  
 Temp. : 40 °C  
 Detection : UV 210 nm  
 Sample : Allantoin

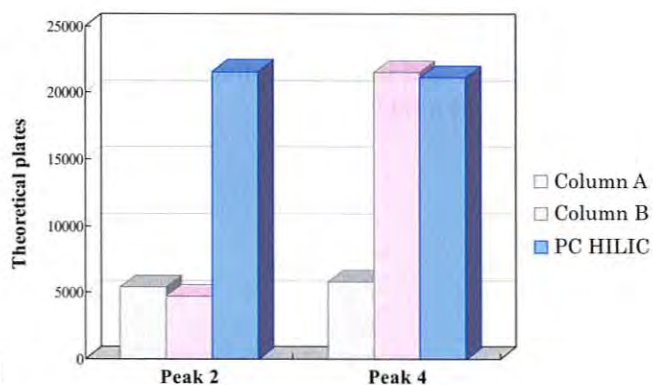
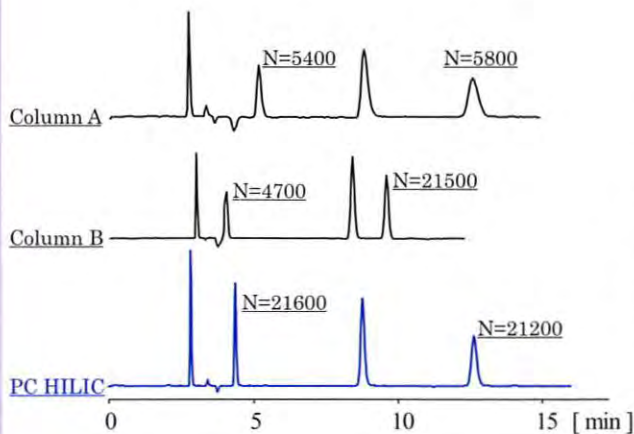


Column : PC HILIC 4.6 x 250 mm, 5 $\mu$ m  
 M. phase : 10 mmol/L HCOONH<sub>4</sub> in 90% CH<sub>3</sub>CN  
 Flow rate : 1 mL/min  
 Temp. : 30 °C  
 Detection : UV 254 nm  
 Sample : Amitriptyline

Amitriptyline, a compound with a strong basicity, is often used for discussing the quality of columns. PC HILIC provides excellent peak shapes for basic compounds, too.

## High Column Efficiency

PC HILIC shows large numbers of theoretical plates, compared to conventional HILIC columns.



Column : PC HILIC 4.6 x 250 mm, 5 $\mu$ m  
 M. phase : 10 mmol/L HCOONH<sub>4</sub>, CH<sub>3</sub>CN/H<sub>2</sub>O=90/10, pH=3.5  
 Flow rate : 1 mL/min  
 Temp. : 40 °C  
 Detection : UV 254 nm  
 Sample : 1. Naphthalene, 2. Thymine,  
 3. Adenine, 4. Cytosine



## Features

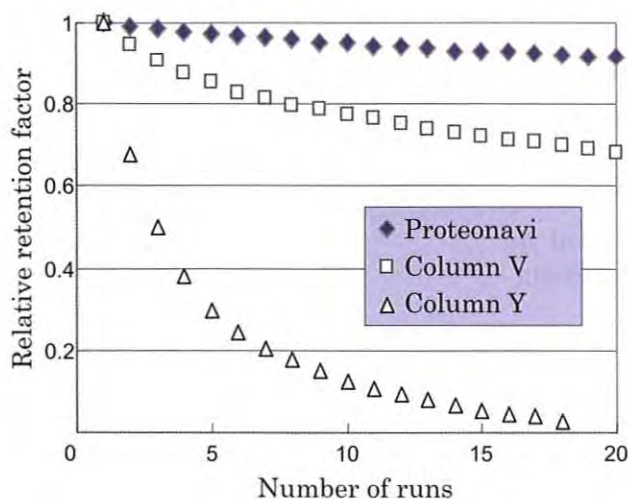
- Excellent acidic durability!
- Minimal protein adsorption! Minimum sample loss!
- Easy to shift from analytical to preparative size!

Adsorption to a stationary phase is one of the most common limiting factors in protein separation in reversed-phase mode. It is generally understood that the irreversible adsorption is caused by denaturing of protein in the hydrophobic phase or a coulombic interaction with silica, a chromatographic support. Proteonavi has overcome the problem by introducing the short four- carbon structure on the silica surface with a unique chemistry. Its synthetic process has already been established for even a large industrial-scale purification.

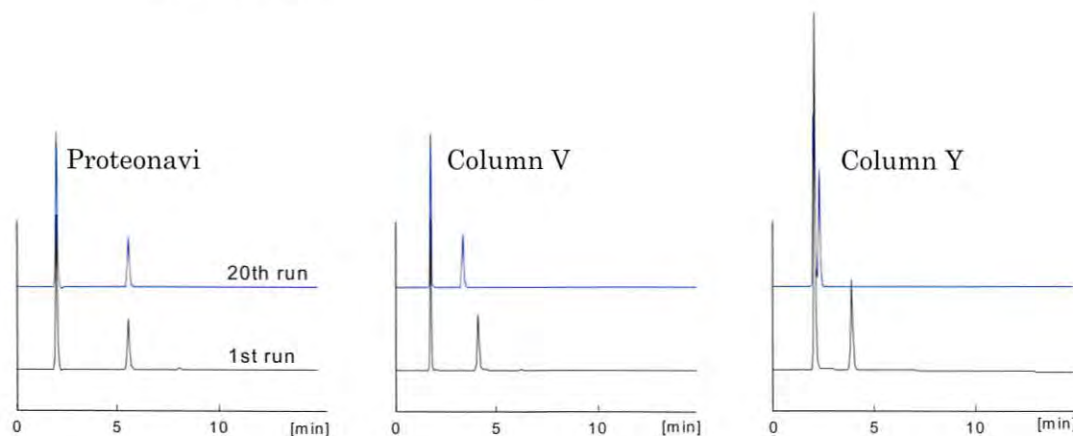
## Outstanding Acid Durability

Acidic hydrolysis is the major cause of loss in performance in reversed phase. Proteonavi's durability under acidic conditions was proven by the accelerated test using 1vol% of trifluoroacetic acid (TFA), a concentration one order of magnitude higher than those used for mobile phases for common protein separations.

**Sequence of process:** After thermal equilibration of column, start the pump. Sixty minutes later, run the sample and record its retention time. Repeat the sequence in every 60 minutes and observe the loss of retention. (For HPLC condition, see below.)

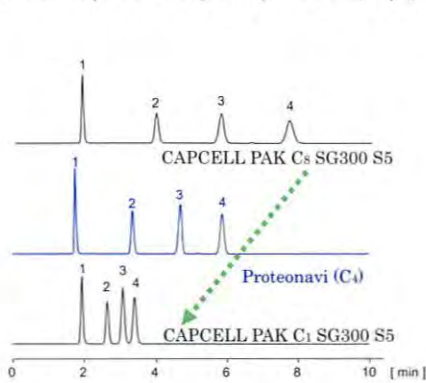


M. phase : 1 vol% TFA, H<sub>2</sub>O / Methanol = 90 / 10  
 Flow rate : 1 mL/min  
 Temp. : 60°C  
 Detection : UV 254 nm  
 Sample : Uracil (50 µg/mL), Benzylalcohol (1 mg/mL)  
 Injection vol. : 7 µL inj.

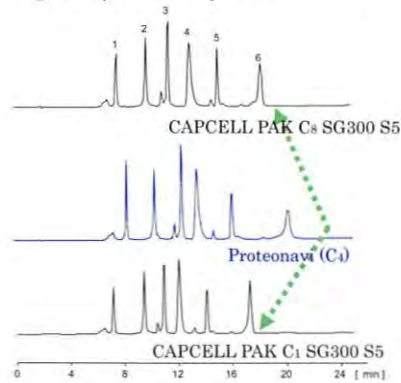


## Specific Retention for Proteins

While their retention times of small neutral compounds are supposed to be correlated to amount or length of alkyl chains of stationary phase, that of protein is, in general, governed not only by hydrophobic interaction, but by hydrophilic or ionic interactions. Proteonavi is designed to show large retention specifically for proteins, by precisely controlling its synthetic process.



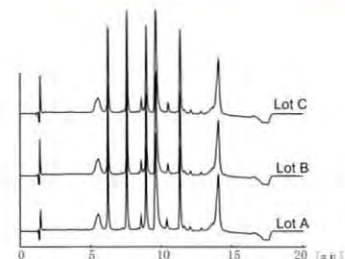
Column size : 2.0 mm i.d. x 150 mm  
 Mobile phase : CH<sub>3</sub>CN / H<sub>2</sub>O = 40 / 60  
 Flow rate : 200 μL/min  
 Temp. : 40 °C  
 Detection : UV 254 nm  
 Sample : 1. Uracil, 2. Methyl benzoate,  
 3. Toluene, 4. Naphthalene



Column size : 2.0 mm i.d. x 150 mm  
 Mobile phase : A) 0.1vol% TFA / H<sub>2</sub>O  
 B) 0.1vol% TFA / CH<sub>3</sub>CN  
 B 20% (0 min) → 70% (25 min) Gradient  
 Flow rate : 200 μL/min  
 Temp. : 40 °C  
 Detection : UV 220 nm  
 Sample : 1. Ribonuclease A, 2. Cytochrome C,  
 3. Lysozyme, 4. B.S. albumin,  
 5. Myoglobin, 6. Ovalbumin

## Minimal Lot Variation

Lot-to-lot variation in separation is often discussed in protein analysis. Proteonavi's silica support and its synthetic procedure are precisely controlled to minimize it.

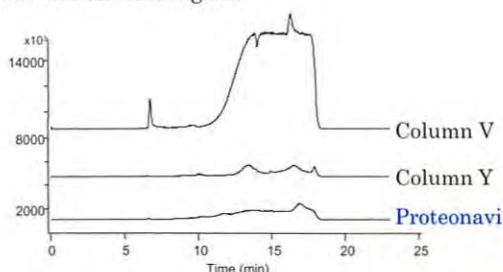


【HPLC Condition】  
 same as the above

## Reduced Column Bleed

Total ion chromatograms in LC-MS were compared among competitor's columns under validated gradient conditions. Proteonavi showed the least column bleed, and is expected to provide high purification efficiency in preparative applications, as well as a high sensitivity in LC-MS.

Total ion chromatogram



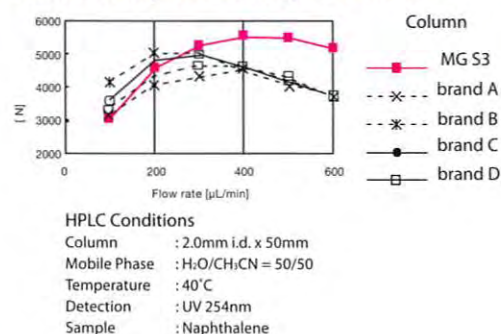
Column size : 2.0 mm i.d. x 150 mm  
 Mobile phase : A) 0.1vol% TFA / H<sub>2</sub>O, B) 0.1vol% TFA / CH<sub>3</sub>CN,  
 B: 5% → 95% (10min) → 95% (12min) →  
 5% (12.1min) Gradient  
 Flow rate : 200 μL/min  
 Detection : LC-MS (AccuTOF)

A column for LC-MS and HTS should be inert, and background-free. Polymer-coated Capcell Pak was designed to correspond to such a need. In response to different analytes and conditions, Shiseido proudly provides the chromatographers with improved separation tools.

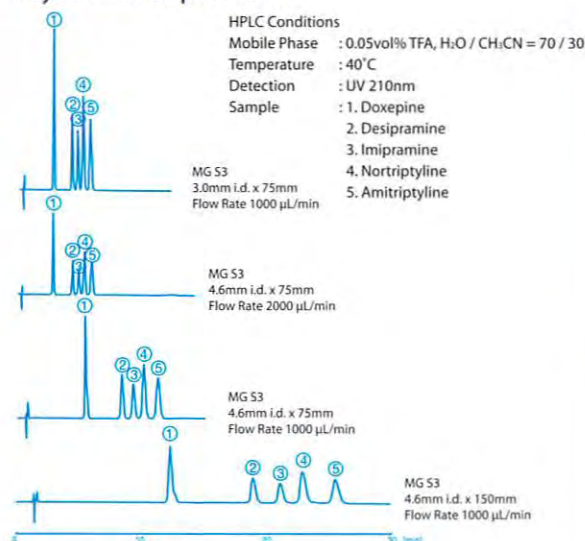
Column	Phases	Characteristics
MGIII	C <sub>18</sub>	Excellent reproducibility of basic compounds under acidic conditions, Low bleeding
MGII	C <sub>18</sub>	Minimized residual silanol, ideal for basic compounds under neutral conditions
MG	C <sub>18</sub>	High-efficiency separation and well-balanced retention for diverse compounds
UG	C <sub>18</sub> , C <sub>8</sub> , Ph, CN	Good retention for hydrophobic compounds, fast separation of basic and polar compounds
ACR	C <sub>18</sub>	Excellent acidic durability (pH 1~10)
AQ	C <sub>18</sub>	Suitable for aqueous mobile phases to be used for polar compounds
DD	C <sub>8</sub>	Superb acidic and basic durability
CR	C <sub>18</sub> +SCX	Provides a large retention for basic compounds
PC HILIC	PC	Excellent retention and separation of very polar and hydrophilic compounds
Proteonavi	C <sub>4</sub>	Specific retention for proteins and excellent acidic durability

## High efficiency at higher flow rate, Capcell Pak C<sub>18</sub> MG, MGII, MGIII S3

3- $\mu$ m CAPCELL PAK shows a large number of theoretical plates at high flow rates



## Tricyclic antidepressants



## Semi-microcolumn of 1.0-2.0mm i.d.

Semi-microcolumn of 1.0-2.0mm i.d. is extremely effective in the high sensitivity analysis. The benefits of reducing the inner diameter of the column are:

- Improvement in absolute sensitivity of a concentration-sensitive detector
- Reduction of mobile phase consumption
- Reduction of baseline noise in LC-MS
- Small Amounts of packing material result in a good dynamic range for substances causing an irreversible adsorption on a stationary phase



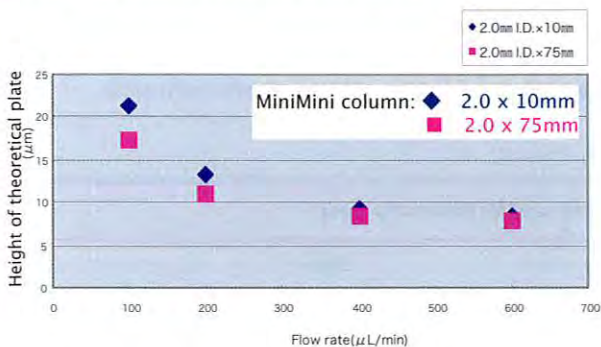
### MiniMini columns

Low pressure • Fast separation • Long lifetime

2.0 mm i.d. x 10 mm 

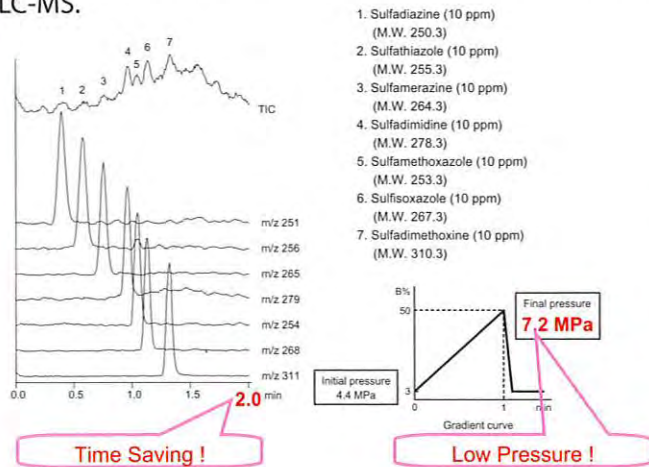
1.5 mm i.d. x 10 mm 

### Designed for fast separation



### Low-pressure and Rapid LC-MS of seven sulfa drugs

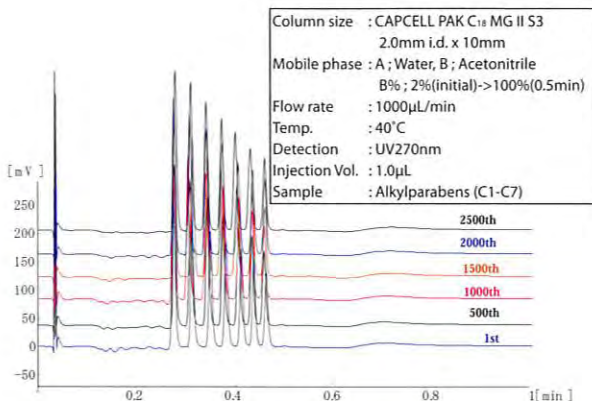
Simultaneous analysis of seven sulfa drugs was attempted with a MiniMini column (1.5mm i.d. x 10mm), which provided high-resolution separation with a low pressure at a high flow rate in LC-MS.



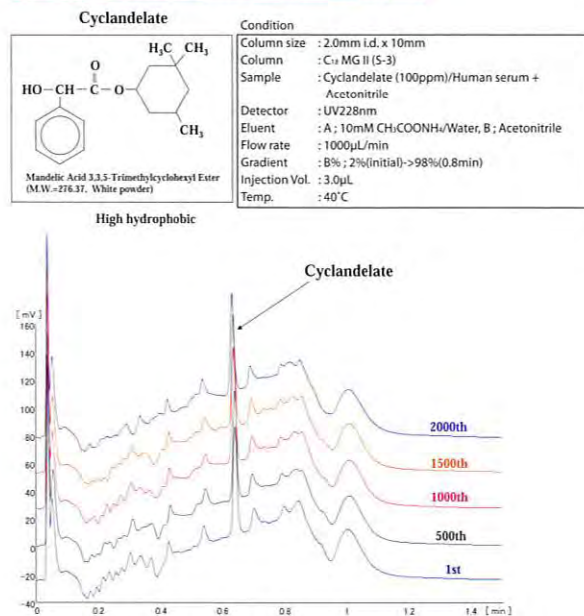
### Long lifetime--Durability Test

The original polymer coating and column packing technology bring the excellent durability and lifetime.

### Durability test by continuous operations of Alkylparabens



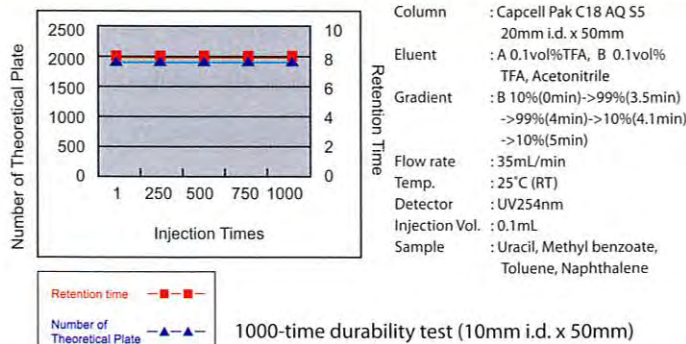
### Durability test by continuous operations of a serum-derived sample



http://hplc.shiseido.co.jp/main

### Columns for combinatorial chemistry

The unique performance of high efficiency and low pressure is attributed to a narrow distribution of particle diameter. Capcell Pak is suitable to preparative separation in combinatorial chemistry.



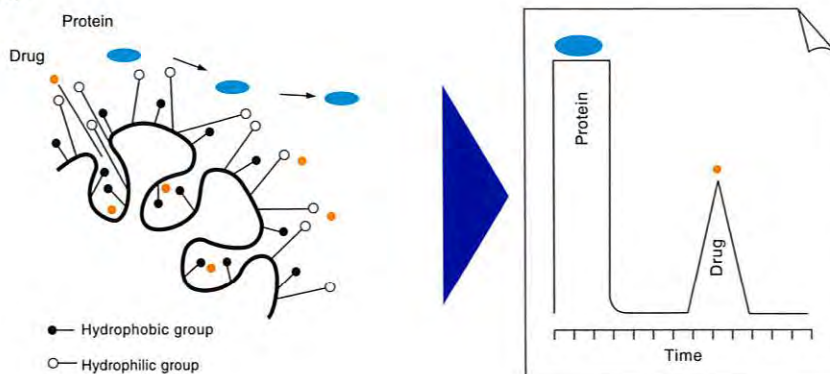
1000-time durability test (10mm i.d. x 50mm)

**CAPCELL PAK MF is a mixed-function phase for direct analysis of drugs contained in serum, plasma or other body fluids.**

- Direct injection of body fluids
- High recovery of drugs
- Very reproducible
- Higher sensitivity using column switching method
- Available as analytical columns and guard cartridges
- Available in four different functional groups

Using the same polymer coating technology, CAPCELL PAK MF is designed to allow the direct injection of serum or other biological fluids, without tedious and time-consuming pretreatment procedures. This is done by bonding hydrophilic polyoxyethylene groups and hydrophobic groups (phenyl, C<sub>8</sub>, C<sub>18</sub>, SCX) to the polymer coated silica. This allows proteins to pass through the column and elute in the void volume due to restricted access to the surface of the packing, while retaining a drug of interest on the small hydrophobic phase. CAPCELL PAK MF columns have three main functions.

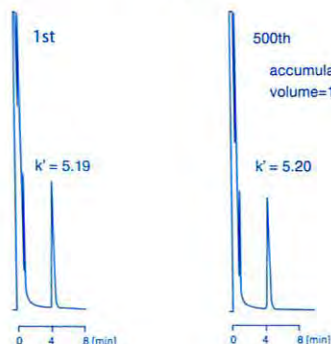
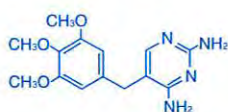
- 1) Protein removal
- 2) Sample concentration
- 3) Sample analysis



## EXCELLENT DURABILITY

### Analytical column

Column : CAPCELL PAK MF Ph-1  
4.6mm i.d. x 100mm  
Mobile Phase : 0.1 mol/L Phosphate buffer / CH<sub>3</sub>CN = 90 / 10 (pH6.98)  
Flow Rate : 1.0mL/min  
Temperature : 40°C  
Detection : UV 254nm  
Sample : Trimethoprim



### Cartridge column

Column : CAPCELL PAK MF Ph-1 Guard Cartridge  
4.0mm i.d. x 10mm  
Mobile Phase : 100mmol/L Phosphate buffer (pH6.9) / CH<sub>3</sub>CN = 90 / 10  
Flow Rate : 1.0mL/min  
Temperature : 40°C  
Detection : UV 254nm  
Sample : Phenytoin

