Core-shell Technology

CAPCELL CORE

OSAKA SODA

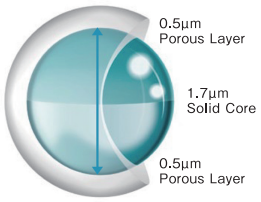
Core-shell Column of Osaka Soda
CAPCELL CORE Series

OSAKA SODA

Structure of Core-shell Type Packing Material

The core-shell type packing material has a non-porous solid core in the porous layer. Solutes injected by the sampler are separated by the porous layer on the packing material surface; the construction of this layer characterizes the packing material. In other words, the capability of this separation field appears as the result of separation. The base material used in CAPCELL CORE is a packing material of 2.7 μm particle size with a 0.5 μm porous layer covering a 1.7 μm solid core (Fig. 1).

Fig. 1 Core-shell structure



Basic Properties of Core-Shell Type Packing Material (1)

Since the diffusion field for the injected sample is smaller in the core-shell packing material than the fully porous packing material, a chromatogram with a narrower peak width and higher peak intensity is obtained (Fig. 2).

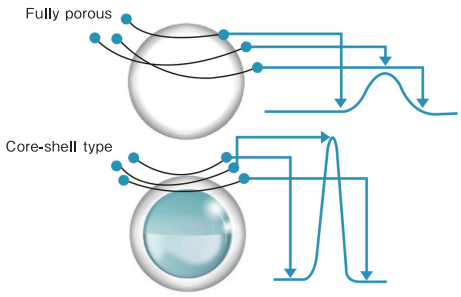


Fig. 2 Diffusion of sample due to the structural difference in packing material and chromatogram obtained

Basic Properties of Core-Shell Type Packing Material (2)

We can understand from the van Deemter curve (Fig. 3) that the height of the theoretical plate decreases (number of theoretical plates increase) as the particle size decreases.
While the number of theoretical plates increases, the disadvantage of packing materials used at present has been that the smaller the particle size, the higher the column pressure.CAPCELL CORE is a packing material that provides separation equivalent to sub2 μm while keeping the column pressure in control thanks to its core-shell structure (Fig. 4).

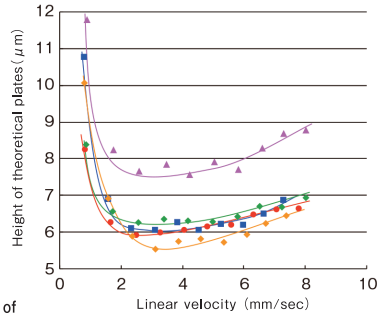


Fig. 3 the van Deemter curve

- Fully porous 3 μm
- Fully porous 2.2 μm
- Core-shell product of another company 2.6 μm
- CAPCELL CORE 2.7 μm
- Fully porous 1.8 μm

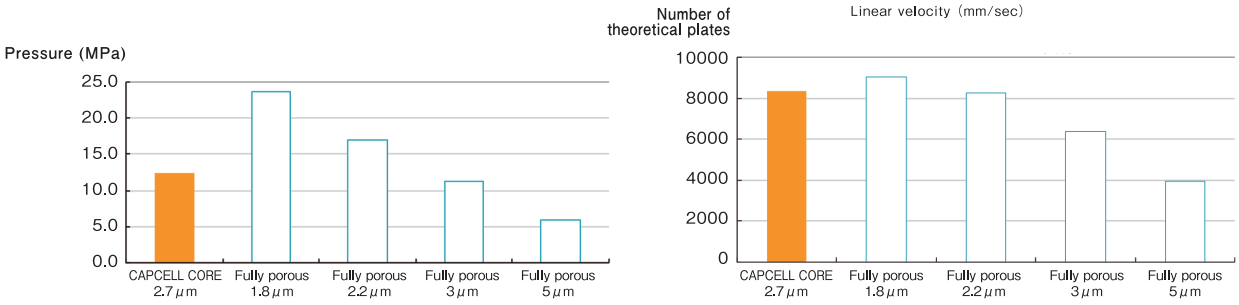
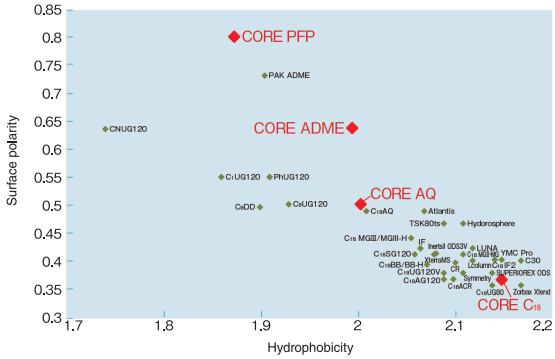


Fig. 4 Comparison of pressure and number of theoretical plates for a fully porous column

CAPCELL CORE Lineup

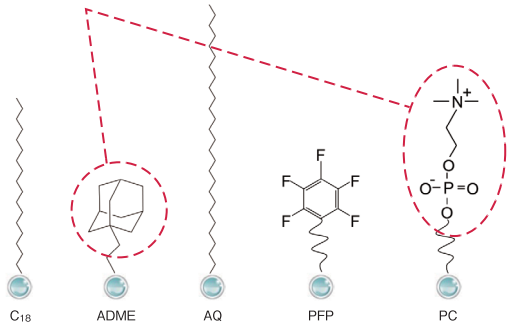
"CAPCELL CORE" series of Osaka Soda has a unique lineup of products, including the C18 type "CAPCELL CORE C18", a highly versatile column over a wide pH range, as well as the ADME (Adamantyl) and PC (Phosphorylcholine) groups, which are the functional groups commonly used for "CAPCELL PAK" series, and the C27 (Heptacosyl) and PFP (Pentafluorophenyl) groups, which are the original functional groups of the core-shell series.

Functional group	Product name	USP class No.	Particle Size (μm)	Pore Size (Å)	Surface Area (m^2/g)	% of Carbon	Density (μmol/m^2)	pH range	Pressure resistance (MPa)	End-fitting Style
C18 (octadecyl groups)	CAPCELL CORE C18	L1	2.7	90	150	7	2.9	1.5 - 10	60	Parker type (UP type)
	CAPCELL CORE MP		2.7	160	90	5	2.6	2 - 10	60	Parker type (UP type)
ADME (Adamantyl group)	CAPCELL CORE ADME	–	2.7	90	150	5.5	2.5	2 - 9	60	Parker type (UP type)
C27 (heptacosyl group)	CAPCELL CORE AQ	–	2.7	160	90	4	1.4	2 - 10	60	Parker type (UP type)
PFP (pentafluorophenyl group)	CAPCELL CORE PFP	L43	2.7	90	150	5	3.1	2 - 8	60	Parker type (UP type)
PC (phosphorylcholine group)	CAPCELL CORE PC	–	2.7	90	150	–	0.94	3 - 7.5	60	Parker type (UP type)



CAPCELL CORE Parameter map

Even functional groups "ADME" and "PC" used in CAPCELL PAK



CAPCELL CORE functional group lineup

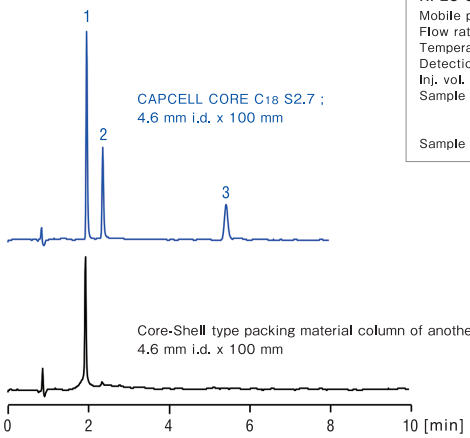
CAPCELL CORE C18 / MP

1st Choice C18 of Core-Shell Type

Highly versatile 1st Choice C18 column of core-shell type.
Pore diameter can be selected from 2 types according to the molecular weight of the target compound.

Reduces the Adsorption of Chelating Compounds

The elution behavior of chelating compounds Hinokitiol, Ciclopirox ethanolamine, and Piroctone olamine was compared.
These chelating compounds elute with good peak shapes in the CAPCELL CORE C18 column.
On the other hand, the peak intensity of Hinokitiol was also small, and elution of the other two chelating compounds was not observed in another company's column with core-shell packing material.
The CAPCELL CORE C18 column is also useful for the analysis of chelating compounds.

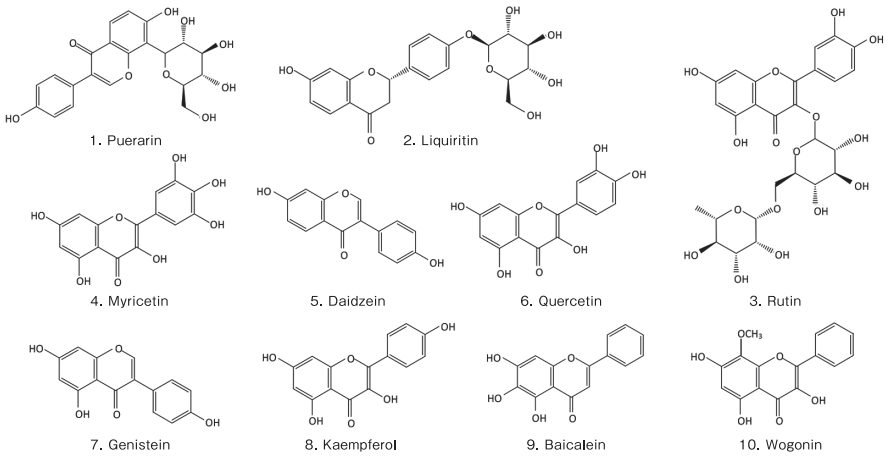


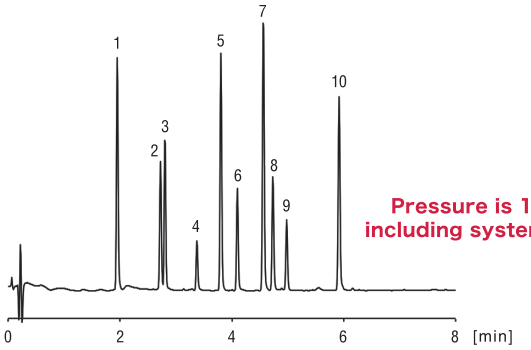
HPLC Conditions

Mobile phase	: 0.1 vol% H_3PO_4, H_2O / CH_3CN = 50 / 50	
Flow rate	: 1.0 mL/min	
Temperature	: 40 ℃	
Detection	: UV 310 nm	
Inj. vol.	: 2 µL	
Sample	: 1. Hinokitiol	50 µg/mL
	2. Ciclopirox olamine	50 µg/mL
	3. Piroctone olamine	50 µg/mL
Sample dissolved in	: Mobile phase	

Simultaneous Analysis of Flavonoids

The following is an analysis example of ten flavonoids using the CAPCELL CORE C18 column.
Flavonoids having a similar structure tend to require a longer analysis time as sufficient separation must be obtained.
Here, the flow rate is 600 µL/min, three times the standard flow rate.
Ten flavonoids, including some with coordination properties, could be analyzed in about 6 minutes with good peak shapes.
Pressure is also maintained at about 20 MPa.





Pressure is 19.2 MPa, including system pressure

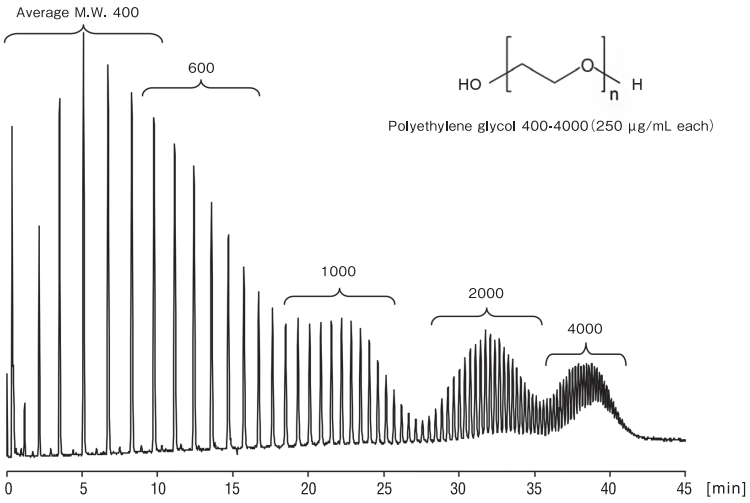
HPLC Conditions

Column	: CAPCELL CORE C18 S2.7; 2.1 mm i.d. × 50 mm
Mobile phase	: A) 0.1 vol% HCOOH, H_2O
	B) 0.1 vol% HCOOH, CH_3CN
	B 5 % (0 min) -> 40 % (8 min) -> 5 % (8.1 min) -> 5 % (10 min) Gradient
Flow rate	: 600 µL/min
Temperature	: 40 ℃
Detection	: UV 254 nm
Inj. vol.	: 1 µL

Middle pore (MP) Type Useful for High Molecular Weight Compounds

Polyethylene glycol

Polyethylene glycol (PEG) is used in many industrial applications, including cosmetics.
Analysis example of an equal weight mixture of average molecular weight from 400 to 4000 using NQAD as the detector is shown.
Chromatograms faithfully showing the weight distribution that cannot be obtained with mass spectrometry were obtained.



HPLC Conditions

Column	: CAPCELL CORE MP S2.7 ; 2.1 mm i.d. × 50 mm
Mobile phase	: A) H_2O, B) CH_3CN
	B 5 % (0 min) -> 40 % (45 min) -> 5 % (45.1 min) Gradient
Flow rate	: 400 µL/min
Temperature	: 50 ℃
Detector	: NQAD (Evaporation 35 ℃, Nebulizer 30 ℃, Filter 2.5 sec)
Inj. vol.	: 2 µL
Sample dissolved in	: Each standard was dissolved in 20 % CH_3CN at 10 mg/mL. All the solutions were mixed together, and diluted with 20 % CH_3CN, so that concentration of each type was 250 µg/mL.

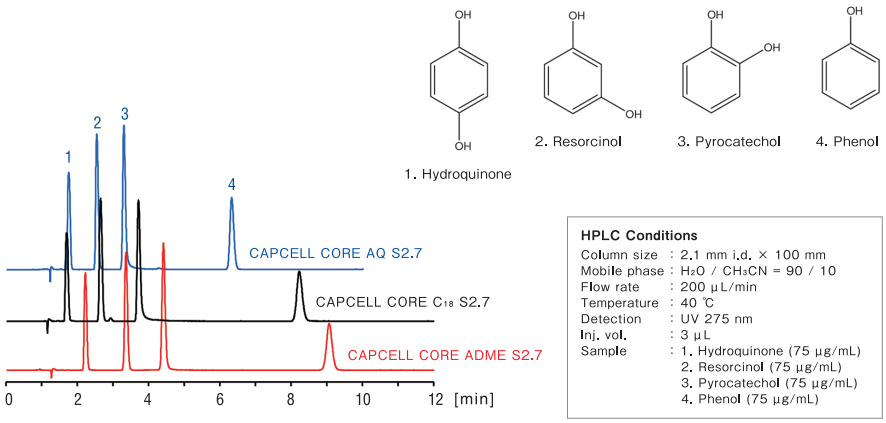
CAPCELL CORE ADME

Proprietary functional groups with unique selectivity that are ideal for highly polar compounds

A core-shell column in which Osaka Soda's original functional group, the adamantyl group, has been introduced. This group is also used commonly in the CAPCELL PAK series
Similar to the CAPCELL PAK ADME-HR column, unique selectivity and high retention for highly polar compounds can be achieved with the cage-shaped functional groups.

High Surface Polarity

The figure shows data comparing the retention of highly polar compounds in the CAPCELL CORE C18, CAPCELL CORE AQ and CAPCELL CORE ADME columns.
We can understand from the figure that the retention of the CAPCELL CORE ADME column is higher for highly polar compounds with hydroxyl groups.
Although CAPCELL CORE ADME and CAPCELL CORE AQ columns show comparable hydrophobicity, we can observe that high surface polarity, which is a feature of the cage-shaped ADME group, works predominantly.



HPLC Conditions

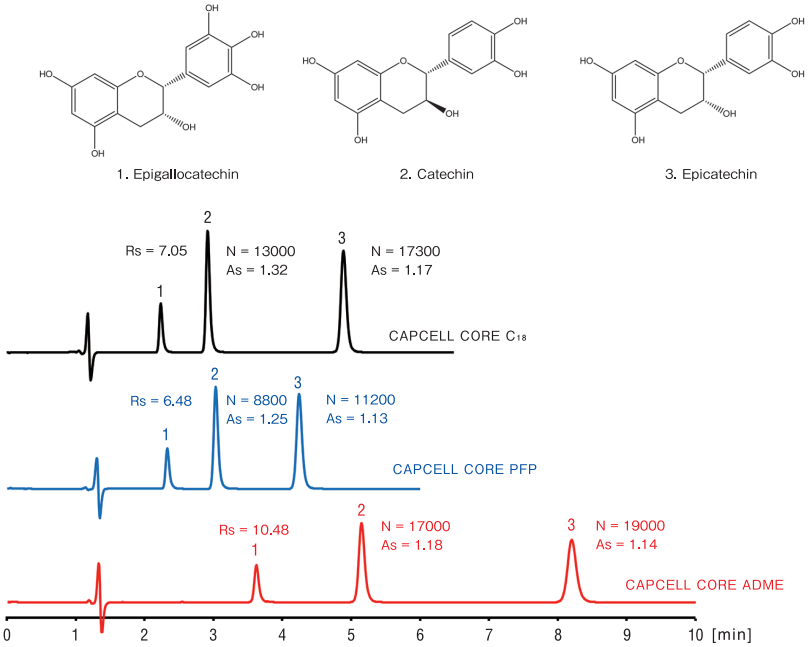
Column size	: 2.1 mm i.d. × 100 mm
Mobile phase	: H_2O / CH_3CN = 90 / 10
Flow rate	: 200 µL/min
Temperature	: 40 ℃
Detection	: UV 275 nm
Inj. vol.	: 3 µL
Sample	: 1. Hydroquinone (75 µg/mL) 2. Resorcinol (75 µg/mL) 3. Pyrocatechol (75 µg/mL) 4. Phenol (75 µg/mL)

Comparison of Catechin Retention

The retention of the CAPCELL CORE C18, CAPCELL CORE PFP and CAPCELL CORE ADME columns were compared using catechins as samples.
The CAPCELL CORE ADME column showed higher retention than the CAPCELL CORE PFP column with a higher surface polarity parameter.

HPLC Conditions

Column size	: 2.1 mm i.d. × 100 mm
Mobile phase	: 0.1vol% HCOOH, H_2O / CH_3CN = 90 / 10
Flow rate	: 200 µL/min
Temperature	: 40 ℃
Detection	: UV 280 nm
Inj. vol.	: 1 µL
Sample	: 1. Epigallocatechin 2. Catechin 3. Epicatechin

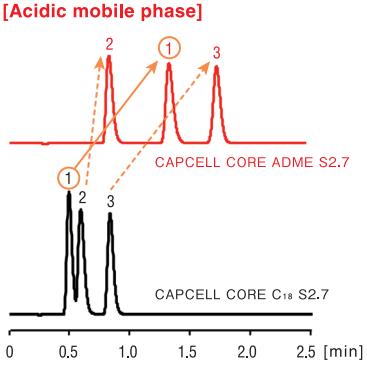


Acetaminophen and its Metabolites

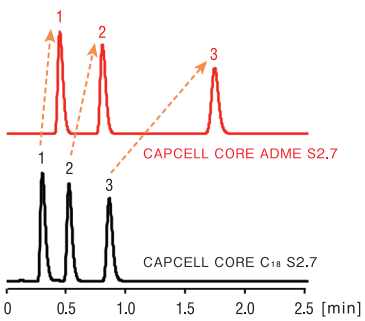
- Elution behavior in acidic and neutral mobile phases -

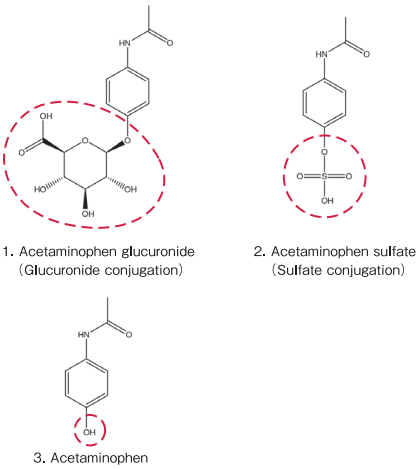
Data comparing the elution behavior of the CAPCELL CORE ADME and CAPCELL CORE C18 columns using samples of each compound in the metabolic pathway of acetaminophen is shown in the figure.
We can understand that the retention of the CAPCELL CORE ADME column is high in acidic and mobile phases.
In addition, since the glucuronic acid conjugate suppresses the dissociation of the carboxyl group under acidic conditions and turns into a carboxyl group in the molecular state, the retention increases due to the high surface polarity of the CAPCELL CORE ADME column.
As a result, this column exhibits an elution pattern different from the CAPCELL CORE C18 column.
Since ADME columns with modified adamantyl groups can retain and separate highly polar compounds such as metabolites compared to widely used C18 columns, they are expected to separate the peaks of impurities that elute near the void volume.

[Acidic mobile phase]



[Neutral mobile phase]





HPLC Conditions

Column	: CAPCELL CORE ADME S2.7 ; 2.1 mm i.d. × 50 mm CAPCELL CORE C18 S2.7 ; 2.1 mm i.d. × 50 mm
Mobile phase	: Acidic ; 0.1 vol% HCOOH / CH_3OH = 95 / 5 Neutral ; 10 mmol/L $HCOONH_4$ / CH_3OH = 95 / 5
Flow rate	: 500 µL/min
Temperature	: 40 ℃
Detection	: UV 254 nm
Inj. vol.	: 2 µL
Sample dissolved in	: H_2O / CH_3OH = 95 / 5 (25 µg/mL each)

CAPCELL CORE AQ (C27)

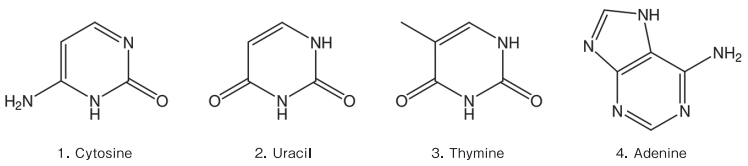
Highly polar core-shell columns for use with 100% aqueous mobile phase

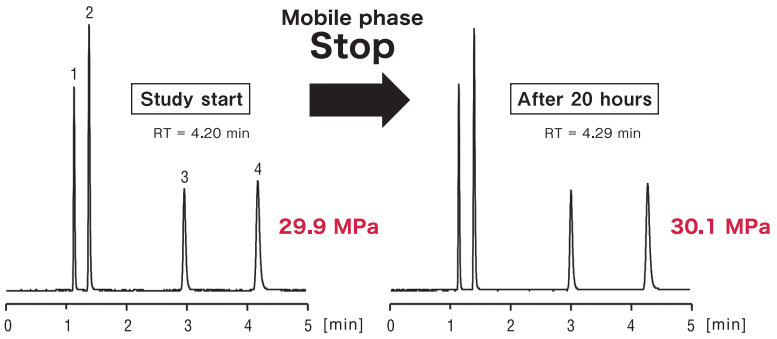
**The CAPCELL CORE AQ column is a highly polar core-shell column with an optimal balance of the C27 (heptacosyl) group.
Try this core-shell column to analyze highly polar compounds under 100% aqueous mobile phase conditions and for compounds that are difficult to separate using the C18 column.**

Can achieve good reproducibility with 100% aqueous mobile phase

The retention reproducibility (stability) in a 100% aqueous mobile phase has been confirmed using nucleic acid bases as the sample. Good retention reproducibility has been obtained even with analysis after the flow is stopped.
The CAPCELL CORE AQ column can be used with stability even in a 100% aqueous mobile phase since the amount of functional groups introduced is optimally controlled.

HPLC Conditions
Column : CAPCELL CORE AQ S2.7 ; 2.1 mm i.d. × 150 mm
Mobile phase : 10 mmol/L $HCOONH_4$
Flow rate : 400 µL/min
Temperature : 40 ℃
Detection : UV 254 nm
Inj. vol. : 1 µL (50 ppm each)

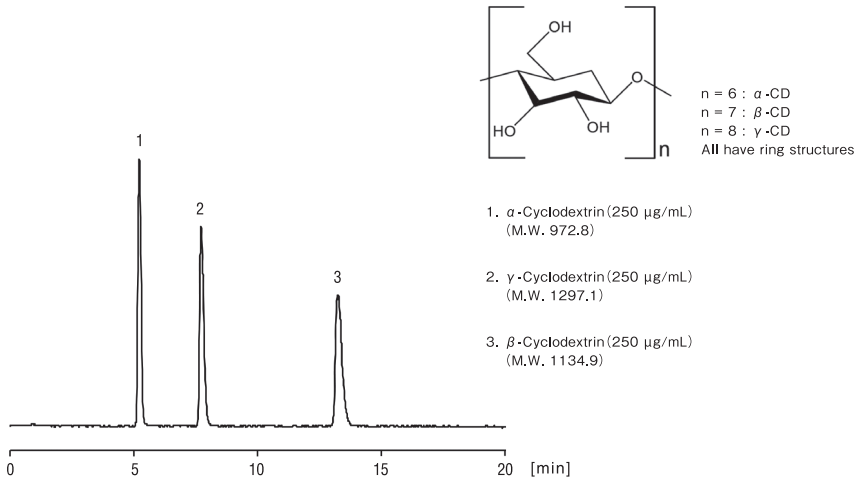




Cyclodextrin

An example of analysis of 3 types of cyclodextrins (α, β and γ bodies) using the CAPCELL CORE AQ column is shown in the figure. Although separation of α and γ bodies was difficult with the CAPCELL CORE C18 column, it was achieved with the CAPCELL CORE AQ column.
Since a long alkyl chain (heptacosyl group) is introduced in the CAPCELL CORE AQ column, it may be useful for compounds that are difficult to separate with an ODS (C18) column.

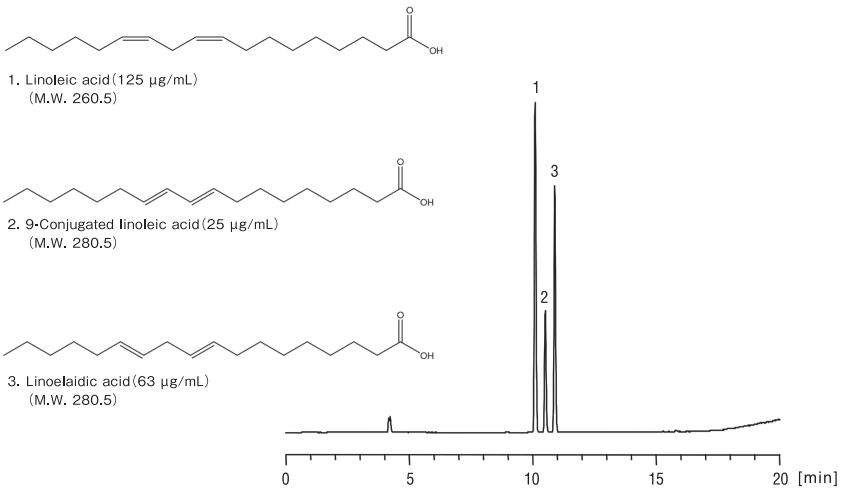
HPLC Conditions
Column : CAPCELL CORE AQ S2.7 ; 2.1 mm i.d. × 100 mm
Mobile phase : 10 mmol/L $HCOONH_4$ / CH_3CN = 98 / 2
Flow rate : 300 µL/min
Temperature : 40 ℃
Detector : NQAD (Evaporation 35℃, Nebulizer 30℃)
Inj. vol. : 1 µL
Sample dissolved in : Mobile phase



Fatty Acids

The following is an example of analyzing three fatty acids (linoleic acid, 9-conjugated linoleic acid, and linoelaidic acid) with similar structures.
Adequate retention and separation were obtained with the CAPCELL CORE AQ column.
The use of NQAD as the detector allows for high sensitivity detection.

HPLC Conditions
Column : CAPCELL CORE AQ S2.7 ; 2.1 mm i.d. × 100 mm
Mobile phase : A) 0.1 vol% HCOOH B) 0.1 vol% HCOOH, CH_3CN
B 60 % (0 min) -> 80 % (10 min) -> 99 % (16 min) -> 99 % (18 min) -> 60 % (19 min) Gradient
Flow rate : 300 µL/min
Temperature : 40 ℃
Detector : NQAD (Evaporation 35 ℃, Nebulizer 30 ℃, Filter 2.5 sec)
Inj. vol. : 2 µL
Sample dissolved in : CH_3CN



CAPCELL CORE PFP

Core-shell column effective for isomer compounds

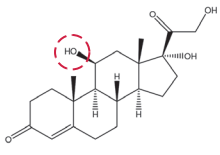
The CAPCELL CORE PFP column in which the PFP (pentafluorophenyl) group is introduced shows selectivity different from the C18 column due to the hydrogen bonding properties of fluorine, dipole-dipole interaction and π-π interaction by π electrons of the benzene ring. The CAPCELL CORE ADME column is a core-shell column similar to the CAPCELL CORE AQ column that should be tried when selectivity has to be changed from C18 columns.

Cortisol and Cortisone

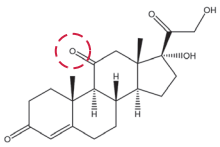
The degree of separation has been improved in the CAPCELL CORE PFP column even though the retention of this column is smaller than the CAPCELL CORE C18 column.
The separation of cortisol and cortisone shows that the CAPCELL CORE PFP column has a better ability to recognize the difference between hydroxyl and carbonyl groups.
The improvement in the degree of separation with the CAPCELL CORE PFP column also indicated the potential for further shortening analysis time by increasing the organic solvent concentration in the mobile phase.

HPLC Conditions

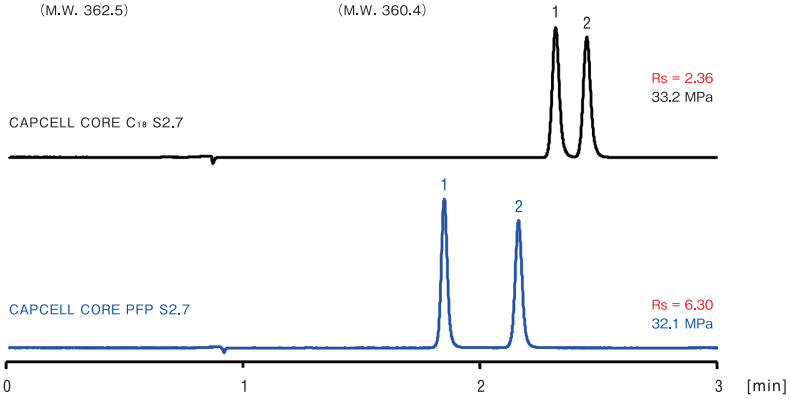
Colum	: CAPCELL CORE C18 S2.7 ; 2.1 mm i.d. × 150 mm CAPCELL CORE PFP S2.7 ; 2.1 mm i.d. × 150 mm
Mobile phase	: H_2O / CH_3CN = 70 / 30
Flow rate	: 400 µL/min
Temperature	: 40 ℃
Detection	: UV 245 nm
Inj. vol.	: 1 µL (25 ppm each)



1. Cortisol (25 µg/mL)
(M.W. 362.5)



2. Cortisone (25 µg/mL)
(M.W. 360.4)

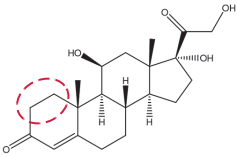


Corticosteroid Hormones

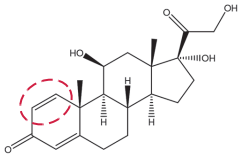
An example of analyzing five corticosteroid hormones is shown below.
The five components of corticosteroid hormones are well separated.
Prednisolone with two double bonds in ring A is retained more than cortisol in CAPCELL CORE PFP (prednisolone elutes first in CAPCELL CORE C18).
This is presumably due to increased retention because of the π-π interaction between the double bond in ring A and PFP (pentafluorophenyl) group.
The speed could be increased while maintaining the separation by doubling the flow rate (from 200 µL/min to 400 µL/min) to analyze corticosteroid hormones introduced here. This reduced the analysis time by approximately half.

HPLC Conditions

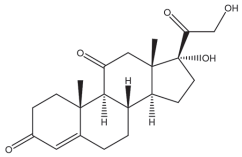
Column	: CAPCELL CORE PFP S2.7 ; 2.1 mm i.d. × 100 mm
Mobile phase	: H_2O / CH_3CN = 80 / 20
Flow rate	: 200 µL/min, 400 µL/min
Temperature	: 40 ℃
Detection	: UV 240 nm
Inj. vol.	: 1 µL



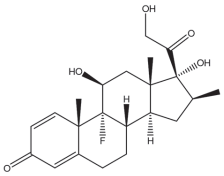
1. Cortisol (50 µg/mL)
(M.W. 362.5)



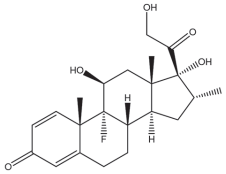
2. Prednisolone (50 µg/mL)
(M.W. 360.4)



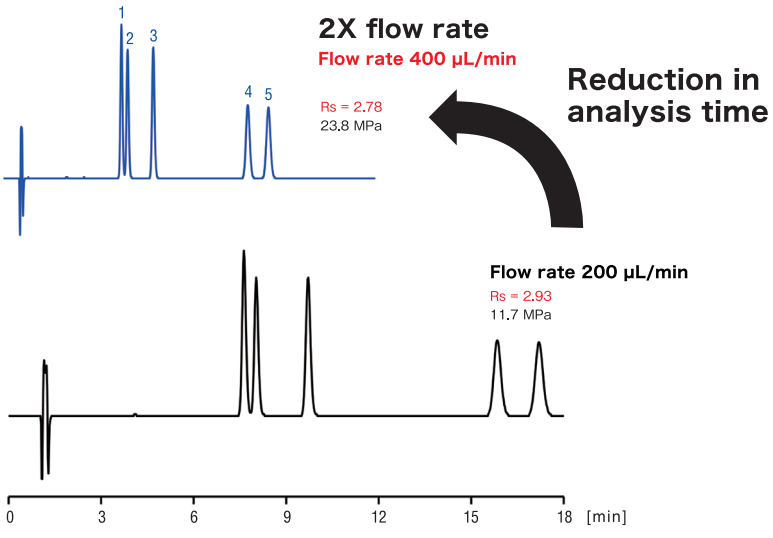
3. Cortisone (50 µg/mL)
(M.W. 360.4)



4. Betamethasone (50 µg/mL)
(M.W. 392.5)



5. Dexamethasone (50 µg/mL)
(M.W. 392.5)



CAPCELL CORE PC

Core-shell columns in HILIC mode with enhanced hydrophilicity

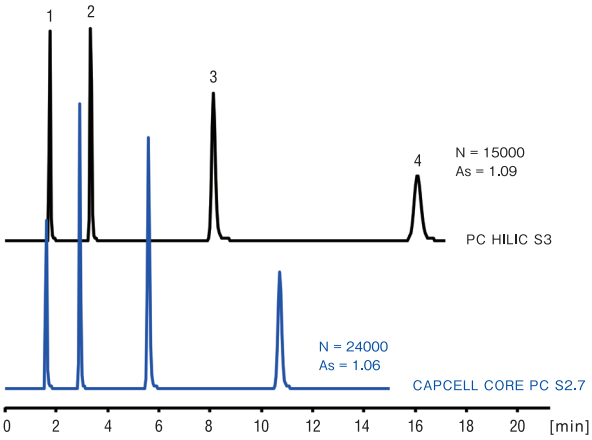
Similar to PC HILIC, a HILIC column with fully porous silica gel, this is a core-shell column in HILIC mode that has been introduced with the PC (Phosphorylcholine) group, which is the hydrophilic component of lecithin.

Comparison of Separation Behavior with PC HILIC

PC (phosphorylcholine) group, which is the same functional group as the fully porous silica gel column PC HILIC is introduced in the CAPCELL CORE PC column.
The elution behavior for four types: naphthalene, thymine, adenine and cytosine, are compared here.
We confirmed the same elution behavior and obtained a higher number of theoretical plates, a feature of core-shell columns, with the CAPCELL CORE PC column.
Although the retention time is also short in proportion to the specific surface area, this column can also be used for short-duration analysis by utilizing these features.
Depending on the purpose, PC HILIC with a large specific surface area can be used when retention is required, while the CAPCELL CORE PC can be used for short duration analysis.

HPLC Conditions

Column	: PC HILIC S3 ; 2.0 mm i.d. × 150 mm CAPCELL CORE PC S2.7 ; 2.1 mm i.d. x 150 mm
Mobile phase	: 5 mmol/L $HCOONH_4$ / CH_3CN = 5 / 95
Flow rate	: 200 µL/min
Temperature	: 40 ℃
Detection	: UV 254 nm
Inj. vol.	: 2 µL
Sample	: 1. Naphthalene 2. Thymine 3. Adenine 4. Cytosine

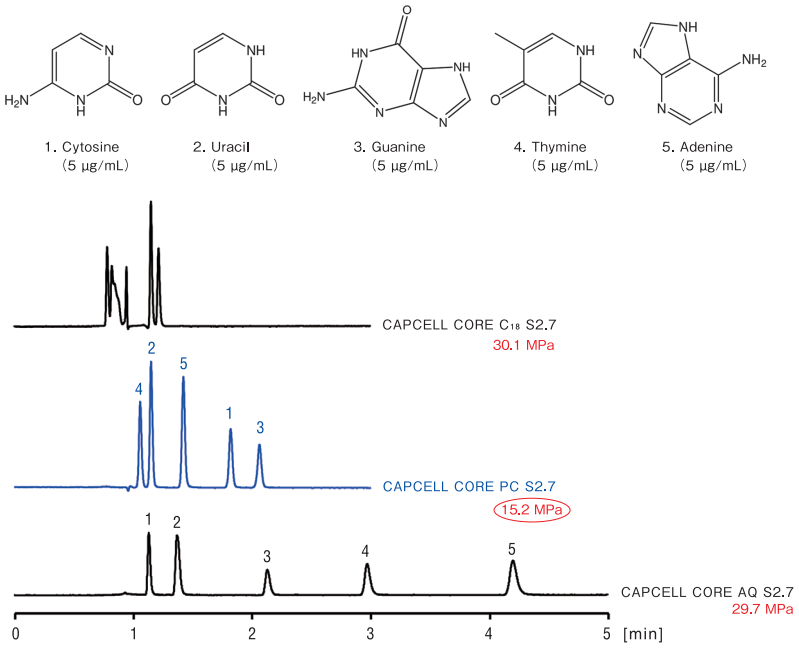


Nucleic Acid Base

Data comparing the elution behavior of the CAPCELL CORE C18, CAPCELL CORE PC and CAPCELL CORE AQ columns for 5 types of nucleic acid base is shown.
CAPCELL CORE C18 is not capable of retaining a highly polar nucleic acid base.
The high surface polarity works effectively in the CAPCELL CORE AQ column, and better retention is obtained than the CAPCELL CORE C18 column.
We can observe that the column is useful even for nucleic acid analysis.
Since the degree of separation is sufficient, further reduction in the analysis time can be expected by increasing the flow rate, but the pressure will also increase.
Let's take a look at the CAPCELL CORE PC column.
The pressure is lower, and the separation of the five nucleic acid base components is achieved in a shorter duration compared to the CAPCELL CORE AQ column.

HPLC Conditions

Mobile phase	
CAPCELL CORE C_{18}	: 10 mmol/L $HCOONH_4$ / CH_3CN = 95 / 5
CAPCELL CORE PC	: 10 mmol/L $HCOONH_4$ / CH_3CN = 15 / 85
CAPCELL CORE AQ	: 10 mmol/L $HCOONH_4$
Flow rate	: 400 µL/min
Temperature	: 40 ℃
Detection	: UV 254 nm
Inj. vol.	: 1 µL

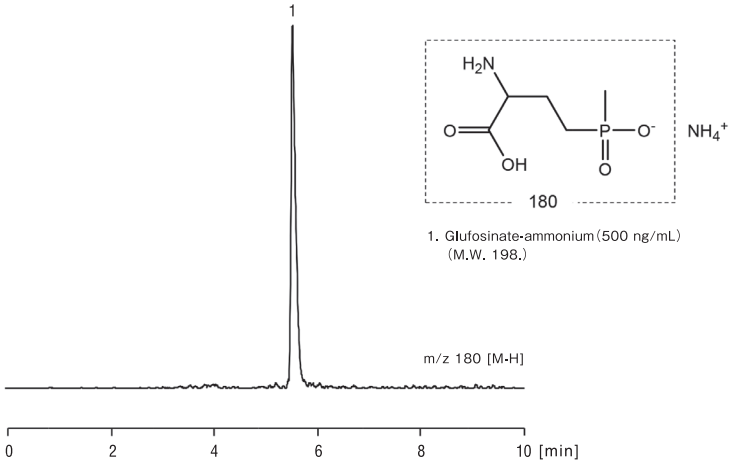


Glufosinate Ammonium

Glufosinate ammonium is an amino acid herbicide that is highly polar and difficult to retain in reverse phase columns. Derivatization is commonly used for high-sensitivity analysis, but an example of direct analysis by LC-MS using the CAPCELL CORE PC column without derivatization is shown here.

HPLC Conditions

Column	: CAPCELL CORE PC S2.7 ; 2.1 mm i.d. × 150 mm
Mobile phase	: A) 100 mmol/L $HCOONH_4$, B) CH_3CN B 90 % (0 min) -> 50 % (3 min) -> 50 % (7 min) -> 90 % (7.1 min) Gradient
Flow rate	: 300 µL / min
Temperature	: 40 ℃
Detection	: MS
Ionization	: ESI Negative
Inj. vol.	: 5 µL
Sample dissolved in	: 50 vol% CH_3CN



CAPCELL CORE Series
Product Lineup

CAPCELL CORE C18

Product number	Type	Particle Size(μm)	Inner diameter(mm)	Length(mm)
51097	C18	2.7	1.0	50
51099	C18	2.7	1.0	100
51100	C18	2.7	1.0	150
51101	C18	2.7	2.1	20
51102	C18	2.7	2.1	35
51103	C18	2.7	2.1	50
51104	C18	2.7	2.1	75
51105	C18	2.7	2.1	100
51106	C18	2.7	2.1	150
51107	C18	2.7	3.0	20
51108	C18	2.7	3.0	35
51109	C18	2.7	3.0	50
51110	C18	2.7	3.0	75
51111	C18	2.7	3.0	100
51112	C18	2.7	3.0	150
51113	C18	2.7	4.6	20
51118	C18	2.7	4.6	30
51114	C18	2.7	4.6	50
51115	C18	2.7	4.6	75
51116	C18	2.7	4.6	100
51117	C18	2.7	4.6	150

CAPCELL CORE MP

Product number	Type	Particle Size(μm)	Inner diameter(mm)	Length(mm)
51212	MP(C18)	2.7	2.1	35
51213	MP(C18)	2.7	2.1	50
51214	MP(C18)	2.7	2.1	75
51215	MP(C18)	2.7	2.1	100
51216	MP(C18)	2.7	2.1	150
51221	MP(C18)	2.7	3.0	100
51222	MP(C18)	2.7	3.0	150
51224	MP(C18)	2.7	4.6	50
51225	MP(C18)	2.7	4.6	75
51226	MP(C18)	2.7	4.6	100
51227	MP(C18)	2.7	4.6	150

CAPCELL CORE ADME

Product number	Type	Particle Size(μm)	Inner diameter(mm)	Length(mm)
51197	ADME	2.7	1.0	50
51198	ADME	2.7	1.0	75
51199	ADME	2.7	1.0	100
51200	ADME	2.7	1.0	150
51182	ADME	2.7	2.1	35
51183	ADME	2.7	2.1	50
51184	ADME	2.7	2.1	75
51185	ADME	2.7	2.1	100
51186	ADME	2.7	2.1	150
51188	ADME	2.7	3.0	50
51189	ADME	2.7	3.0	75
51190	ADME	2.7	3.0	100
51191	ADME	2.7	3.0	150
51193	ADME	2.7	4.6	50
51194	ADME	2.7	4.6	75
51195	ADME	2.7	4.6	100

CAPCELL CORE AQ

Product number	Type	Particle Size(μm)	Inner diameter(mm)	Length(mm)
51161	AQ(C27)	2.7	2.1	20
51162	AQ(C27)	2.7	2.1	35
51163	AQ(C27)	2.7	2.1	50
51164	AQ(C27)	2.7	2.1	75
51165	AQ(C27)	2.7	2.1	100
51166	AQ(C27)	2.7	2.1	150
51171	AQ(C27)	2.7	3.0	100
51172	AQ(C27)	2.7	3.0	150
51174	AQ(C27)	2.7	4.6	50
51175	AQ(C27)	2.7	4.6	75
51176	AQ(C27)	2.7	4.6	100
51177	AQ(C27)	2.7	4.6	150

CAPCELL CORE PFP

Product number	Type	Particle Size(μm)	Inner diameter(mm)	Length(mm)
51141	PFP	2.7	2.1	20
51142	PFP	2.7	2.1	35
51143	PFP	2.7	2.1	50
51144	PFP	2.7	2.1	75
51145	PFP	2.7	2.1	100
51146	PFP	2.7	2.1	150
51154	PFP	2.7	4.6	50
51155	PFP	2.7	4.6	75
51156	PFP	2.7	4.6	100
51157	PFP	2.7	4.6	150

CAPCELL CORE PC

Product number	Type	Particle Size(μm)	Inner diameter(mm)	Length(mm)
51121	PC	2.7	2.1	20
51122	PC	2.7	2.1	35
51123	PC	2.7	2.1	50
51124	PC	2.7	2.1	75
51125	PC	2.7	2.1	100
51126	PC	2.7	2.1	150
51129	PC	2.7	3.0	50
51130	PC	2.7	3.0	75
51131	PC	2.7	3.0	100
51132	PC	2.7	3.0	150
51134	PC	2.7	4.6	50
51135	PC	2.7	4.6	75
51136	PC	2.7	4.6	100
51137	PC	2.7	4.6	150

Guard cartridge column for CAPCELL CORE series (pressure resistance 60 MPa)

Product number	Product name	Particle Size(μm)	Inner diameter(mm)	Length(mm)
3640	EXP® DIRECT CONNECT HOLDER	-	-	5
3643	EXP® GUARD CARTRIDGE CAPCELL CORE C18	2.7	2.1	5
3644	EXP® GUARD CARTRIDGE CAPCELL CORE C18	2.7	4.6	5
3649	EXP® GUARD CARTRIDGE CAPCELL CORE MP	2.7	2.1	5
3648	EXP® GUARD CARTRIDGE CAPCELL CORE ADME	2.7	2.1	5
3645	EXP® GUARD CARTRIDGE CAPCELL CORE AQ	2.7	2.1	5
3647	EXP® GUARD CARTRIDGE CAPCELL CORE PFP	2.7	2.1	5
3646	EXP® GUARD CARTRIDGE CAPCELL CORE PC	2.7	2.1	5

* Purchase both holder (product number 3640) and cartridge.

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* Check our website or the "HPLC Column Price List" for the latest prices.

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