Good Chemistry for Tomorrow Mitsubishi Chemical Holdings Group

please visit
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MCI GEL® TECHNICAL INFORMATION 2011-2013

MITSUBISHI CHEMICAL CORPORATION

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Good Chemistry for Tomorrow Mitsubishi Chemical Holdings Group

MCI GEL®

Mitsubishi chemical's packed columns and packing materials for HPLC

TECHNICAL INFORMATION
2011-2013

Excellent performance

spherical and sharp particle size distribution

Persistence and highest quality

offeres packing materials and packed columns,
under strict quality control

Wide range of product line

MCI GEL® has been designed based on technology of
the world famous Diaion® and Sepabeads®,
specialized in polymeric packing materials including
from analytical to preparative use,
for ion exchange, reversed-phase mode

Abundant accumulation of technology and experience

for more than 30 years, MCI GEL® has been used for
HPLC applications

CONTENTS

1 MCI GEL®
Column selection guide

Nature of sample	Separation mode	MCI GEL® column	pH range	Applications	Pages
Sample → Water Soluble → M.W. >2,000	Size Exclusion	**CQP10, CQP30**	**2 ～12**	Proteins,Biopolymers, Water soluble polymers	28～29
	Ion Exchange	**ProtEx Series**	**2 ～12**	Proteins,Biopolymers	30～34
		CQA Series, CQK Series	**2 ～12**	Proteins,Biopolymers	35～36
	Hydrophobic Interaction	**CQH Series**	**2 ～12**	Proteins,Biopolymers	37～39
	Reversed-Phase	**CMG20/C04, CMG20/C10**	**2 ～12**	Proteins,Biopolymers	40～56
		CHP20/C04, CHP20/C10	**Whole range**	Proteins,Biopolymers	40～56
Sample → Water Soluble → M.W. <2,000	Size Exclusion	**CK02A, CK02AS**	**6 ～ 7**	Oligosaccarides	14～16
		CK04S, CK04SS	**6 ～ 7**	Oligosaccarides	14～16
		CQP06	**2 ～12**	Peptides	28～29
	Ion Exchange	**CK10U**	**1 ～14**	Amino acids	7～ 8
		CA08F, CDR10	**1 ～13**	Organic acids, Saccharrides	17～20
		CDR10	**1 ～13**	Nucleotides	19～20
		SCA04	**3 ～ 7**	Anions	21, 24～26
		SCK01	**1.5～12**	Cations	21～23
	Reversed-Phase	**CMG20/C04, CMG20/C10**	**2 ～12**	Organic Compounds	46～50
		CHP20/C04, CHP20/C10	**Whole range**	Organic Compounds	42～49
	Ion Exclusion	**CK08EH**	**1 ～ 7**	Organic adids	9, 11～12
	Ligand Exchange	**CK08E Series**	**1 ～ 7**	Saccharrides	9～10
		CRS10W, CRS15W	**5 ～ 7**	Optical isomers (α-amino acids・α-hydroxy carboxylic acids)	57～62
Sample → Organic Solvent Soluble → M.W. <2,000	Reversed-Phase	**CHP20/C04, CHP20/C10, CHP07/C04, CHP07/C10**	**Whole range**	Organic Compounds	40～56
		CMG20/C04, CMG20/C10, CHPOD/C04	**2 ～12**	Organic Compounds	40～56

Particle size [μm]	Analytical: 5	Analytical: 10	Preparative: 30	Preparative: 50	Preparative: 150
Ion exchange	CK, CK CA, CDR10, ProtEx	CK CA, CQA_S, CQK_S	CK CA, CQA_P, CQK_P		CK CA
Ion chromatography	SCA	SCK			
Size exclusion		CQP	CQP_P		
Hydrophobic interaction		CQH_S	CQH_P		
Reversed - phase	CHP20/C04, CHP07/C04, CMG20/C04, CHPOD/C04	CHP20/C10, CSP50/P10, CHP50/P20, CHP07/C10, CMG20/C10, CMG20/P10	CHP20/P20, CHP20/P30, CHP50/P30, CMG20/P30, CHPOD/P30	CHP20/P50	CHP20/P70, CHP20/P120, CHP07/P120, CMG20/P150
Ligand exchange	CRS				

2 MCI GEL®
Ion exchange columns and materials

○Cation exchange resins
MCI GEL® CK series

○Anion exchange resins
MCI GEL® CA series

Mitsubishi Chemical Ion Exchange Resins

MCI GEL® specializes in polymer based packing materials. Specifically, polystyrene polymer based ion exchange resins are derived from over 50 years of manufacturing experience of Diaion® product line. MCI GEL® ion exchange resins for HPLC have been developed with the same attention to performance and quality. For several decades, Mitsubishi Chemical has been providing MCI GEL® ion exchange columns are offered in a variety of chemistries, particle sizes and counter ions to support a broad range of applications.

Features

1. Variety of products gel type, porous type, DVB%, particle size, particle size distribution analytical use, preparative use

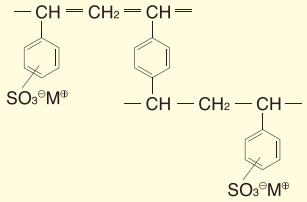
2. Persistence of high quality, excellent separation performance

3. Accumulation of abundant knowledge and experience of applications

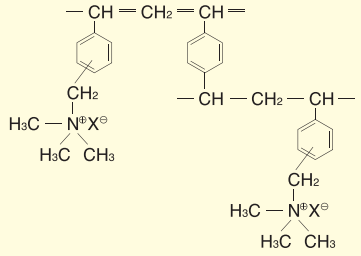
Ion exchange resins are generally used for analysis of amino acids, sugars, organic acids and amines, etc. MCI GEL® custom pre-packed columns are specifically designed for each application using the most appropriate packing material among our product line and using the most suitable column dimensions.
Typical application for each column is shown in this catalog. These data will suggest an appropriate column.

●Chemical structure of ion exchange resin

〈Strongly acidic cation exchange resin〉



〈Strongly basic anion exchange resin〉



●MCI GEL® columns for HPLC

	Product name	Column dimensions I.D×L [mm]	Packing material: Cross linkage [%]	Packing material: Counter ion	Packing material: Particle size [μm]	Typical usage: Amino acid	Mono saccharide	Oligo-saccharide	Carboxylic acid	Amine	Physiological fluid
MCI GEL® Cation exchange columns	MCI GEL® CK10U	6×120	10	Na^+	5	○				○	
	MCI GEL® CK08S	8×500	8	Na^+	11		○				
	MCI GEL® CK08E	8×300	8	Na^+	9		○				
	MCI GEL® CK08EC	8×300	8	Ca^{2+}	9		○				
	MCI GEL® CK08ES	8×300	8	Ag^+	9		○	○			
	MCI GEL® CK08EH	8×300	8	H^+	9		○		○	○	
	MCI GEL® CK04S	10×200	4	Na^+	11			○			
	MCI GEL® CK04SS	10×200	4	Ag^+	11			○			
	MCI GEL® CK02A	20×250	2	Na^+	20			○			
	MCI GEL® CK02AS	20×250	2	Ag^+	20			○			
MCI GEL® Anion exchange columns	MCI GEL® CA08F	4.6×250	8	$Cℓ^-$	7		○		○		
	MCI GEL® CDR10	4.6×250	High porous	AcO^-	7		○		○		○

●Packing materials

Packing materials are available. Please look at P.66 and P.67.

●Description of a gel type ion exchange column

MCI GEL® CK08EC

- for HPLC use
- Cation=K, Anion=A
- DVB%
- Counter ion (no letter=Na^+, C=Ca^{2+}, S=Ag^+, H=H^+)
- Particle size (mode) (A=20μm, S=11μm, E=9μm, F=7μm, U=5μm)

●Note ; Pre-column and guard column

1. Please consider using a guard column concerning purity of injection sample. Guard columns, are listed in the end of this catalog, should be selected in accordance with a main column.
2. As for analysis of amino acids by MCI GEL® CK10U, MCI GEL® AFR2-PC is recommended as a pre-column. The AFR2-PC column is very effective to stabilize base line because it can trap ammonium ion in eluent. A peak caused of the ammonium ion may disturb base line stability.

2 MCI GEL®

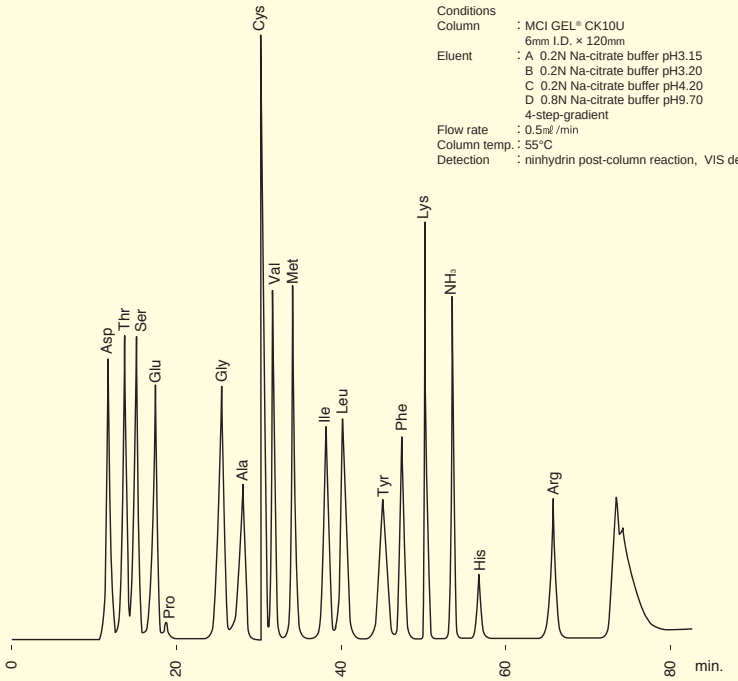
CK10U

High cross linkage cation exchange column
applications; amino acids, amines, etc

CK10U 6×120

Separation of amino acids

Fig. 2-1 Protein hydrolyzates amino acids



As for analysis of amino acids by a cation exchange column such as MCI GEL® CK10U, MCI GEL® AFR2-PC is recommended as a pre-column. The AFR2-PC column is very effective to stabilize base line because ammonium in eluent is trapped in this column. The ammonium ion may disturb base line stability. The AFR2-PC should be installed between an outlet of HPLC pump and an inlet of sample injector. A gradient elution, commonly used for amino acid analysis, is influenced by HPLC instrument. So to obtain a satisfactory chromatogram, gradient conditions should be optimized in accordance with the HPLC equipment.

Separation of amino acids

Fig. 2-2 Valine, β-Alanine

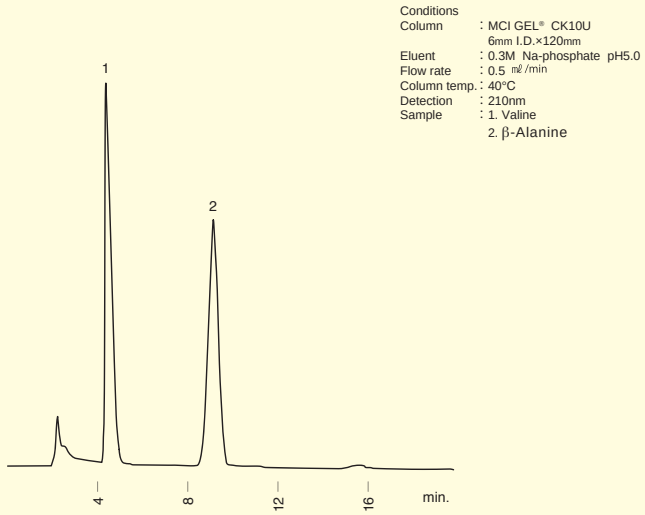
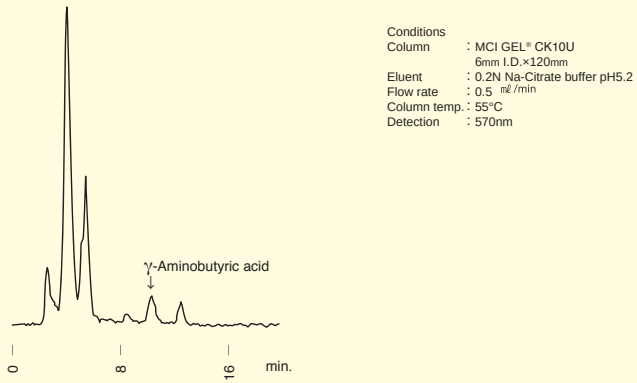


Fig. 2-3 γ-Aminobutyric acid



CK08E series

Cation exchange columns
applications; sugars, carboxylic acids, (poly)alcohols, etc.

CK08EC 8×300　　CK08EH 8×300

●Column list

MCI GEL® column	Counter ion	Application areas
MCI GEL® CK08S MCI GEL® CK08E	Na^+	General sugar separation columns
MCI GEL® CK08EC	Ca^{2+}	The most general sugar separation column Highly recommended for fructose and glucose
MCI GEL® CK08ES	Ag^+	Gel permeation chromatographic effect
MCI GEL® CK08EH	H^+	Organic acids with H_3PO_4 eluent; sugars with distilled water eluent

Application data of CK08EC

Fig. 2-4　Sugars

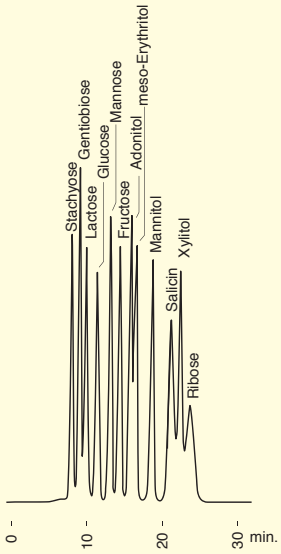
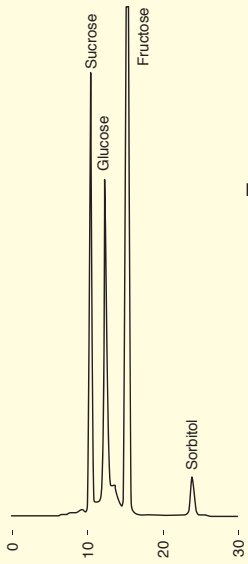
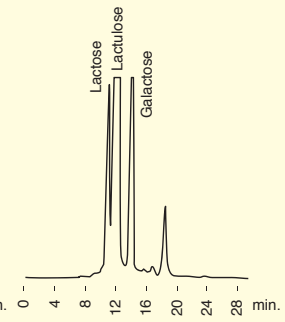


Fig. 2-5　Apple juice



Conditions
Column　: MCI GEL® CK08EC
　　8mm I.D.×300mm
Eluent　: H_2O
Flow rate　: 0.6 mℓ/min
Column temp.　: 75°C
Detection　: RI

Fig. 2-6　Lactulose syrup



Application data of CK08EC

Fig. 2-7　Sports drink A

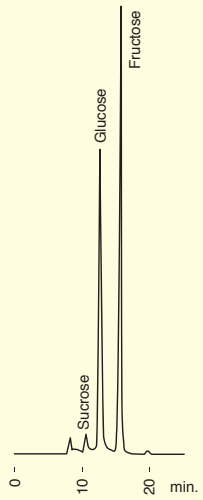


Fig. 2-8　Sports drink B

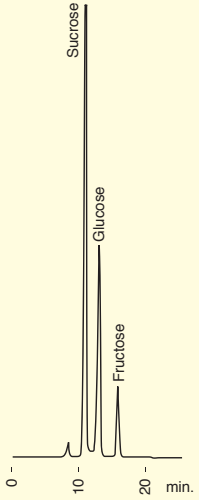


Fig. 2-9　Honey

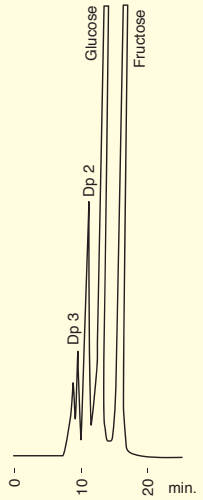


Fig. 2-10　Jam

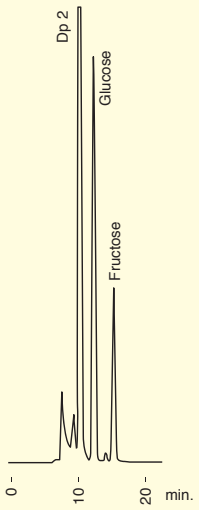
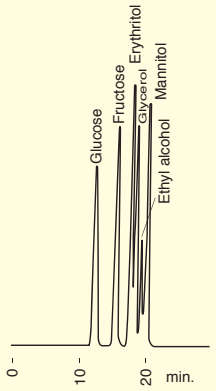


Fig. 2-11　Sugars/Alcohols



Conditions
Column　: MCI GEL® CK08EC
　　8mm I.D.×300mm
Eluent　: H_2O
Flow rate　: 0.6 mℓ/min
Column temp.　: 75°C
Detection　: RI

Application data of CK08EH

Fig. 2-12 Carboxylic acids

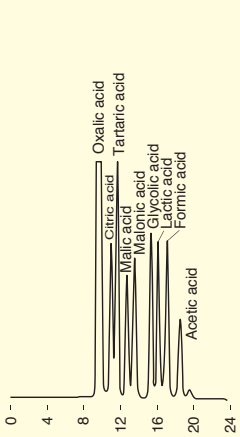


Fig. 2-13 Amino sugars

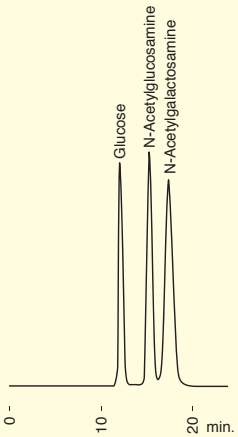
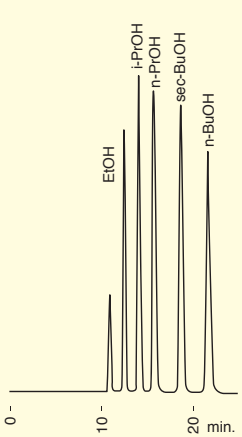


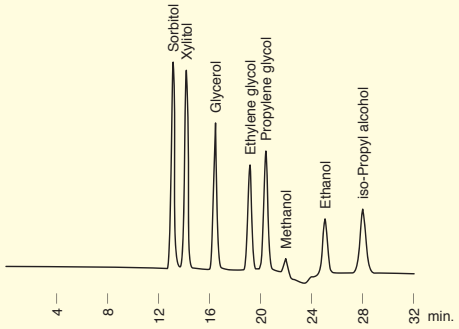
Fig. 2-14 Alcohols



Conditions
Column : MCI GEL® CK08EH, 8mm I.D.×300mm
Eluent : 1% H_3PO_4 (Fig.2-12,2-13), H_2O (Fig. 2-14)
Flow rate : 0.6 mℓ/min
Column temp. : 45°C (Fig. 2-12), ambient (Fig. 2-13), 60°C (Fig. 2-14)
Detection : 210nm (Fig. 2-12), RI (Fig. 2-13, 2-14)

Fig. 2-15 Sugar alcohols/Alcohols

Conditions
Column : MCI GEL® CK08EH
8mm I.D.×300mm
Eluent : H_2O
Flow rate : 0.6 mℓ/min
Column temp. : 45°C
Detection : RI



Application data of CK08EH

Fig. 2-16 Poly alcohols

Conditions
Column : MCI GEL® CK08EH
8mm I.D.×300mm
Eluent : 1% H_3PO_4
Flow rate : 0.6 mℓ/min
Column temp. : 25°C
Detection : RI

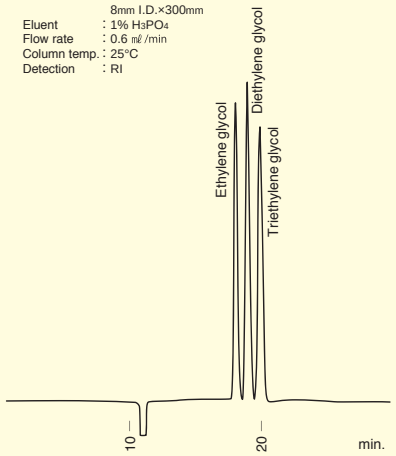


Fig. 2-17 Chloroacetic acids

Conditions
Column : MCI GEL® CK08EH
8mm I.D.×300mm
Eluent : 1% H_3PO_4
Flow rate : 0.6 mℓ/min
Column temp. : 45°C
Detection : 210nm

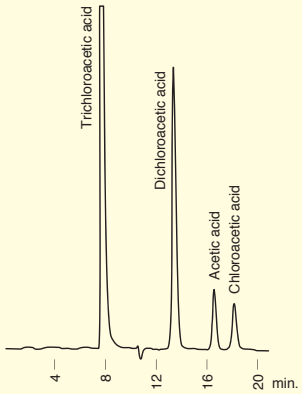
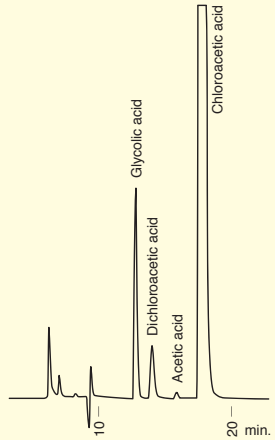
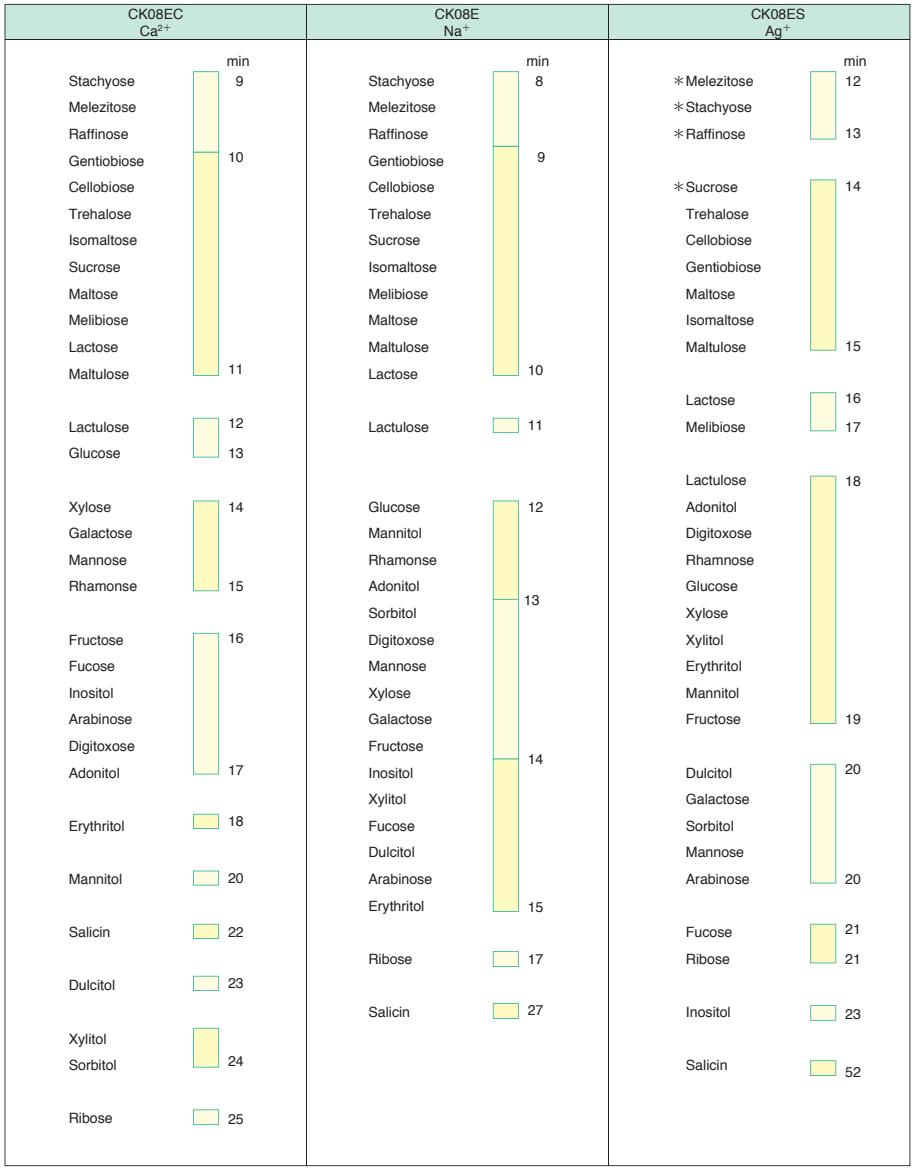


Fig. 2-18 Carboxylic acids

Conditions
Column : MCI GEL® CK08EH
8mm I.D.×300mm
Eluent : 2% H_3PO_4
Flow rate : 0.6 mℓ/min
Column temp. : ambient
Detection : 210nm



●Peak retention time for Sugars and Sugar alcohols on various columns〔min〕



Column temp : CK08EC…75°C, CK08E…45°C, CK08ES…75°C
Column size : 8mm I.D.×300mm
Elueunt : H_2O
Flow rate : 0.6 mℓ/min
Sample : 1% aq. solution
Injection vol. : 20μl

＊; These sugars, containing Fructose component, may partially be decomposed by CK08ES and CK08EH.

2 MCI GEL®

CK04S, CK04SS CK02A, CK02AS

Cation exchange columns
applications; oligosaccharides

The separation mechanism is based on gel filtration chromatography and elution is achieved via simple distilled water. A larger molecule elutes ahead.

CK02A 20×250

CK04S 10×200

CK04SS 10×200

●Separation ability of each column

MCI GEL® column	Counter ion	Separation ability (degree of polymerization)
MCI GEL® CK04S	Na^+	8～9
MCI GEL® CK04SS	Ag^+	12～13
MCI GEL® CK02A	Na^+	15～16
MCI GEL® CK02AS	Ag^+	19～20

Calibration curves of malto-oligosaccharides

Fig. 2-19

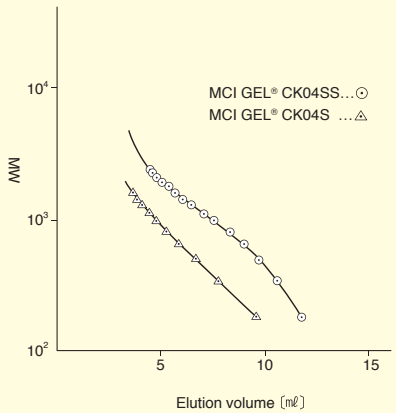
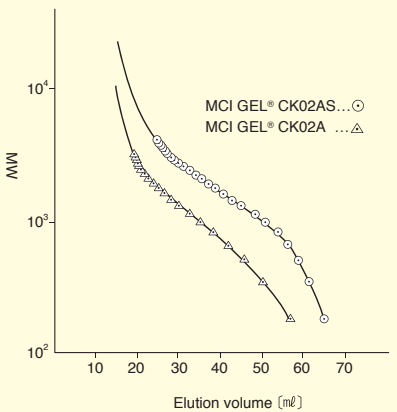


Fig. 2-20



Comparison data of malto-oligosaccharides

Fig. 2-21 MCI GEL® CK04S
10mm I.D.×200mm

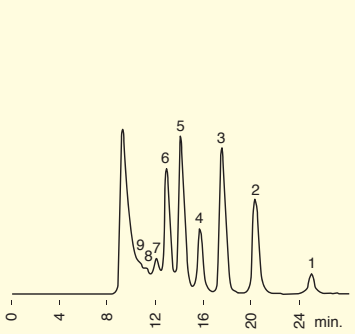


Fig. 2-22 MCI GEL® CK04SS
10mm I.D.×200mm

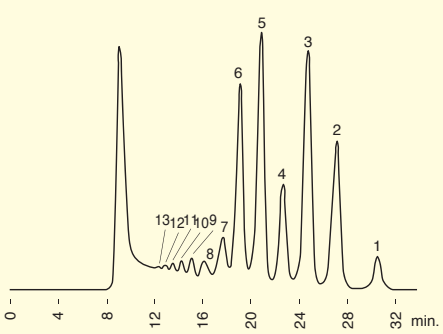


Fig. 2-23 MCI GEL® CK02A
20mm I.D.×250mm

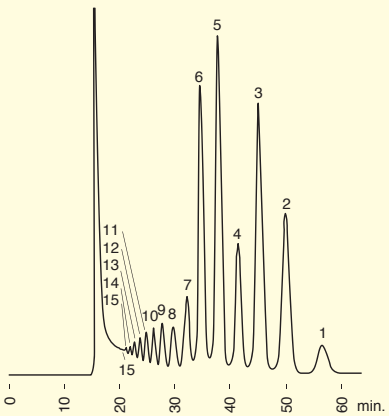
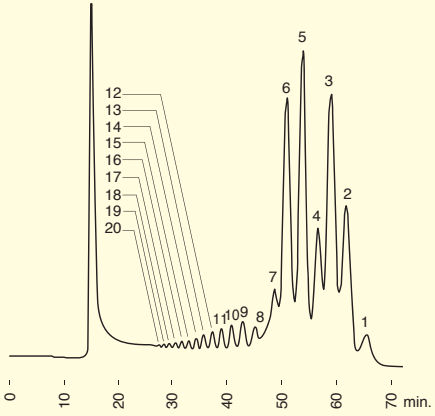


Fig. 2-24 MCI GEL® CK02AS
20mm I.D.×250mm



Conditions
Eluent : H_2O
Flow rate : 0.4 mℓ/min (Fig. 2-21, 2-22, 2-25, 2-26)
1.0 mℓ/min (Fig. 2-23, 2-24, 2-27)
Column temp. : 85°C
Detection : RI

＊On Fig. 2-21 to 2-27, the numbers indicate degree of polymerization.

Comparison data of authentic malto-oligosaccharides samples

Fig. 2-25 MCI GEL® CK04S
10mm I.D.×200mm

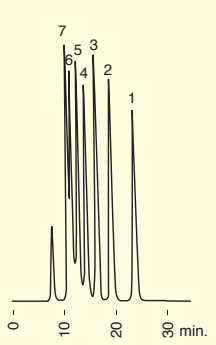


Fig. 2-26 MCI GEL® CK04SS
10mm I.D.×200mm

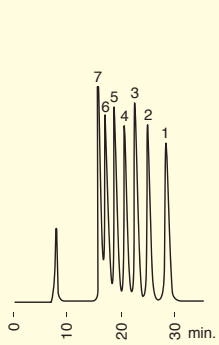
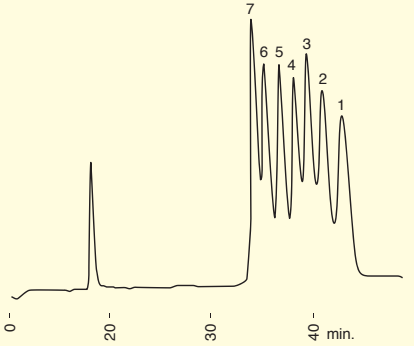


Fig. 2-27 MCI GEL® CK02AS
20mm I.D.×250mm



Application data of CK04S

Fig. 2-28 Honey

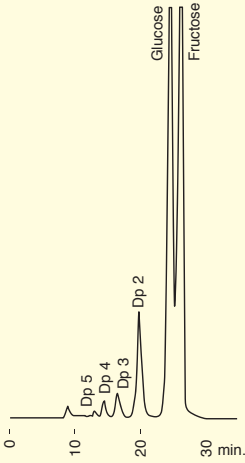


Fig. 2-29 Jam

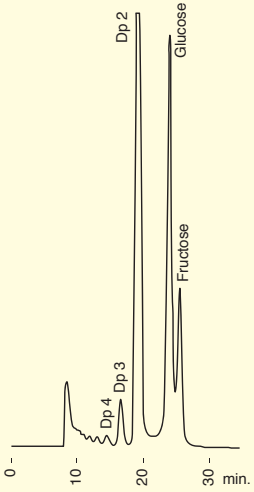
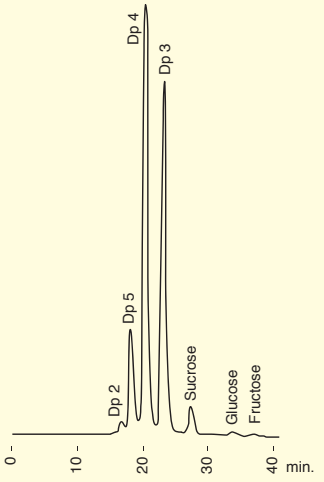


Fig. 2-30 Fructo-oligosaccharides



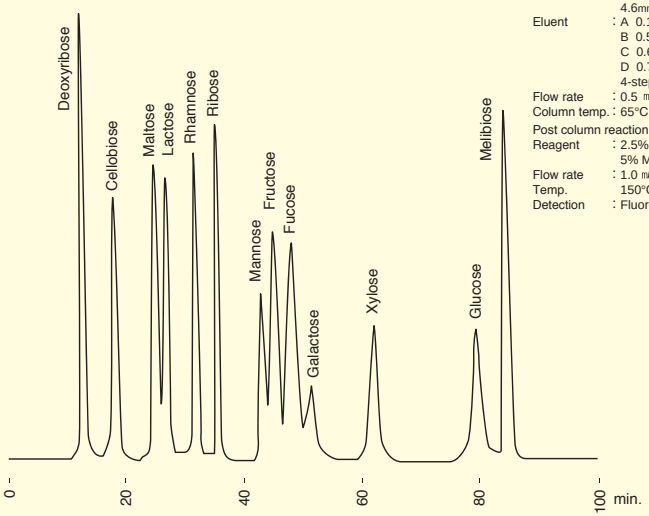
Conditions
Column : MCI GEL® CK04S
10mm I.D.×200mm
Eluent : H_2O
Flow rate : 0.4 mℓ/min (Fig. 2-28, 2-29) 0.3 mℓ/min (Fig. 2-30)
Column temp. : 85°C (Fig. 2-28, 2-29) 45°C (Fig. 2-30)
Detection : RI

CA08F

Anion exchange columns
applications; sugars, carboxylic acids, uncleotides

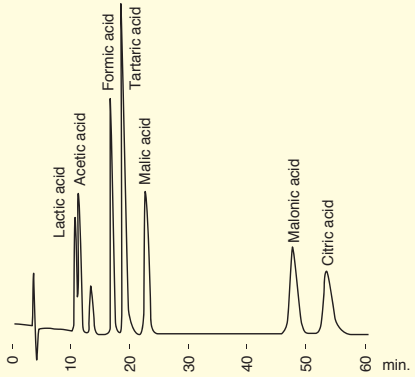
Application data of CA08F

Fig. 2-31 Sugars



Conditions
Column : MCI GEL® CA08F
4.6mm I.D.×250mm
Eluent : A 0.15M Borate buffer pH7.5
B 0.5M Borate buffer pH9.5
C 0.6M Borate buffer pH9.5
D 0.7M Borate buffer pH8.5
4-step-gradient
Flow rate : 0.5 mℓ/min
Column temp. : 65°C
Post column reaction
Reagent : 2.5% Boric acid,
5% Monoethanolamine pH7.9
Flow rate : 1.0 mℓ/min
Temp. 150°C
Detection : Fluorescence Ex 360nm, Em 440nm

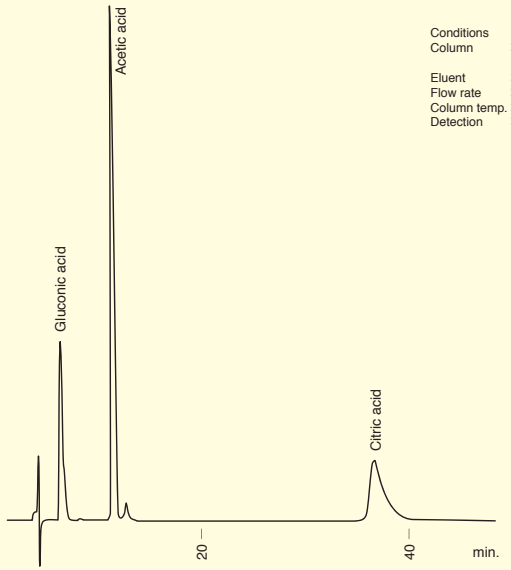
Fig. 2-32 Carboxylic acids



Conditions
Column : MCI GEL® CA08F
4.6mm I.D.×250mm
Eluent : 0.6M Na_2SO_4 pH3.0
Flow rate : 0.5 mℓ/min
Column temp. : 60°C
Detection : 210nm

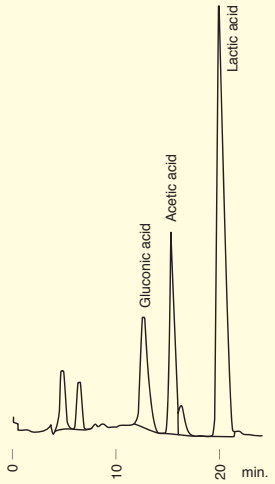
Application data of CA08F

Fig. 2-33 Carboxylic acids



Conditions
Column : MCI GEL® CA08F
4.6mm I.D × 250mm
Eluent : 0.6M Na_2SO_4 pH2.0
Flow rate : 0.5 mℓ/min
Column temp. : 60°C
Detection : 210nm

Fig. 2-34 Carboxylic acids



Conditions
Column : MCI GEL® CA08F
4.6mm I.D × 250mm
Eluent : 0.1M NaH_2PO_4 pH3.3
Flow rate : 0.4 mℓ/min
Column temp. : 55°C
Detection : 210nm

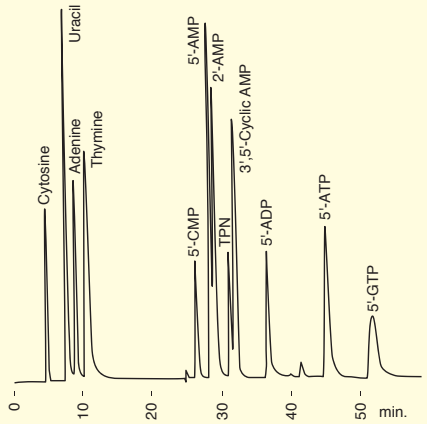
CDR10

High porous type anion exchange columns

Packing material of MCI GEL® CDR10 column is based on a high porous polystyrene functionalized with a quaternary ammonium anion exchange resin. Since a high porous type ion exchange resin is rigid, CDR10 allows usage of aggressive gradient elution, for example water to 6M of acetate buffer gradient. MCI GEL® CDR10 is highly recommended for rapid analysis of physiological fluids like urine and blood.

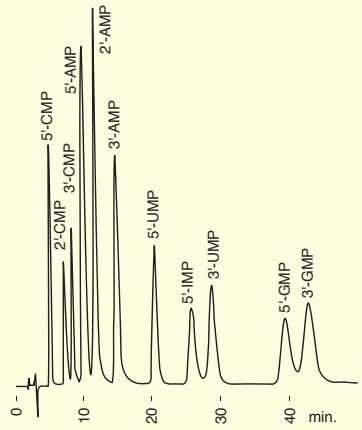
Application data of CDR10

Fig. 2-35 Nucleic acids and related substances



Conditions
Column : MCI GEL® CDR10 4.6mm I.D.×250mm
Eluent : A H₂O
B 6M Acetate buffer pH4.4
A→B 30min linear gradient
Flow rate : 0.5 mℓ/min
Column temp. : 60°C
Detection : 254nm

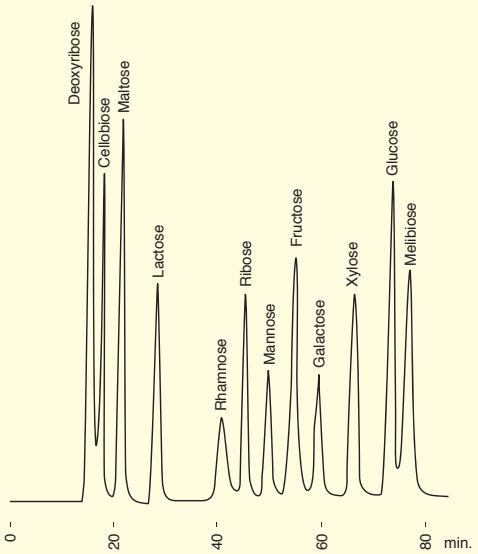
Fig. 2-36 Mono-nucleotides



Conditions
Column : MCI GEL® CDR10 4.6mm I.D.×250mm
Eluent : 1M Acetate buffer pH3.3
Flow rate : 1.2 mℓ/min
Column temp. : 60°C
Detection : 254nm

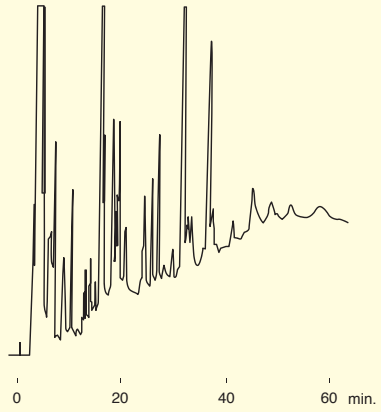
Application data of CDR10

Fig. 2-37 Sugars



Conditions
Column : MCI GEL® CDR10 4.6mm I.D.×250mm
Eluent : A 0.15M Borate buffer pH7.5
B 0.6M Borate buffer pH9.5
A→B60min linear gradient
Flow rate : 0.5 mℓ/min
Column temp. : 65°C
Post column reaction
Reagent : 2.5% Boric acid, 5% Monoethanolamine pH7.9
Flow rate : 0.5
Temp. : 150°C
Detection : Fluorescence Ex 360nm, Em 440nm

Fig. 2-38 Human urine



Conditions
Column : MCI GEL® CDR10 4.6mm I.D.×250mm
Eluent : A 0.006M Acetate buffer pH4.4
B 6M Acetate buffer pH4.4
A→B 60min. linear gradient
Flow rate : 1.0 mℓ/min
Column temp. : 60°C
Detection : 254nm

3 MCI GEL®
Ion chromatography columns and materials

◯**Cation chromatography column**
MCI GEL® SCK01

◯**Anion chromatography column**
MCI GEL® SCA04

The MCI GEL® ion chromatography columns are based on surface functionalized cation and anion exchange resins designed for non-suppressed ion chromatography applications. The non-suppressed ion chromatography is an analysis technique of cations and anions with combination of a packed column of low capacity ion exchange resin and low concentration of electrolyte solution as an eluent. The advantage of the ion chromatography is that several ions can be analyzed by only one injection with free of complicated sample pre-treatment.

Cation chromatography column MCI GEL® SCK01

Packing material of MCI GEL® SCK01 is crosslinked polystyrene functionalized with sulfonic acid. This column is characterized by excellent resolution and rapid analysis for monovalent and divalent cations. Standard monovalent cations like Li+, Na+, NH4+, K+, Rb+, Cs+ and simple amines such as mono-, di- and trimethylamine can be resolved using a nitric acid solution as eluent. Divalent cations, such as alkaline earth metals and transition metal elements, can be efficiently resolved using tartaric acid and complexing reagent such as ethylene diamine to selectively elute the metals from the column.

■Note:
When using the MCI GEL® SCK01 column for monovalent cations, it is recommended that a pre-column, MCI GEL® SCK-PC, be used to trap heavy metals which might otherwise poison the SCK01 column resulting in a rapid loss of capacity and chromatographic performance.

Anion chromatography column MCI GEL® SCA04

Packing material of MCI GEL® SCA04 is based on a hydrophilic viniyl polymer matrix functionalized with quaternary ammonium group and particle size of 5 µm. A solution of potassium hydrogen phthalate and a vanilic acid (VA)/N-methyldiethanolamine (MDEA) solution both can be used as a mobile phase. The unique VA/MDEA eluent, is developed for the SCA04 column, which allows users to determine 7 standard anions in 14 minutes without system peak.

■Note:
A pre-column, MCI GEL® SCA-PC is recommended for prevention of contamination to the SCA04 column when the VA/MDEA eluent is used. The SCA-PC is effectively prolong SCA04 column life. The SCA-PC should be installed between an outlet of HPLC pump and an sample injector.

SCA04 4.6×150 PEEK

Column list

Cation analysis	MCI GEL® SCK01	6mm I.D×50mm	Stainless steel column
Cation analysis	MCI GEL® SCK01	4.6mm I.D×150mm	Stainless steel column
Pre-column for cation analysis	MCI GEL® SCK-PC	6mm I.D×50mm	Stainless steel column
Anion analysis	MCI GEL® SCA04	4.6mm I.D×150mm	Stainless steel column PEEK column
Pre-column for anion analysis	MCI GEL® SCA-PC	8mm I.D×10mm	Stainless steel column

●**Packing materials**
Packing materials are available. Please look at P.67.

Application data of SCK01

Fig. 3-1 Monovalent cations

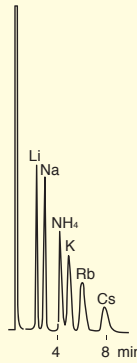


Fig. 3-2 Amines

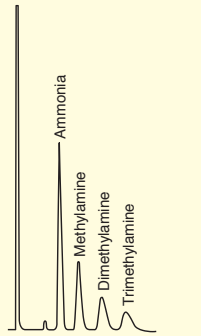


Fig. 3-3 Monovalent cations in rain

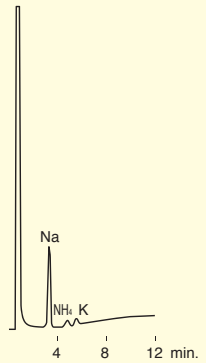


Fig. 3-4 Monovalent cations in tap water

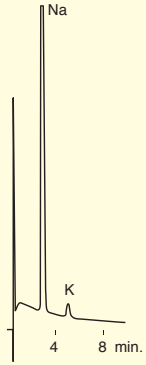


Fig. 3-5 Sports drink

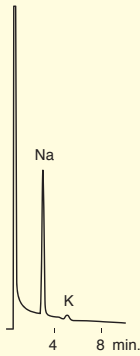
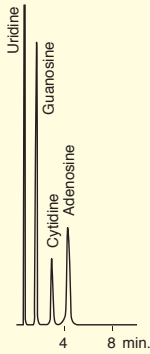


Fig. 3-6 Nucloside



Conditions
Column : MCI GEL® SCK01 6mm I.D.×50mm
Eluent : 5mM HNO_3
Flow rate : 1.0 mℓ/min
Column temp. : 40°C
Detection : Conductivity (Fig. 3-1, 3-2, 3-3, 3-4, 3-5) 254nm (Fig. 3-6)

Application data of SCK01

Fig. 3-7 Alkaline earth metals

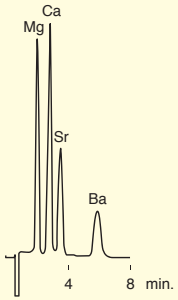


Fig. 3-8 Transition metals

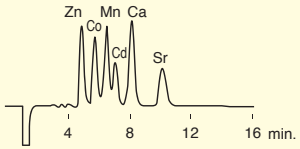


Fig. 3-9 Divalent cations

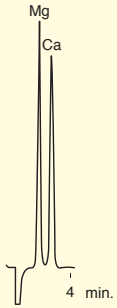


Fig. 3-10 Sports drink A

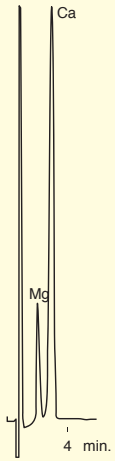
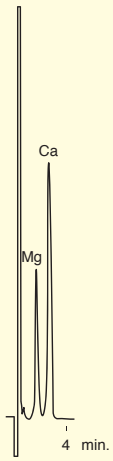


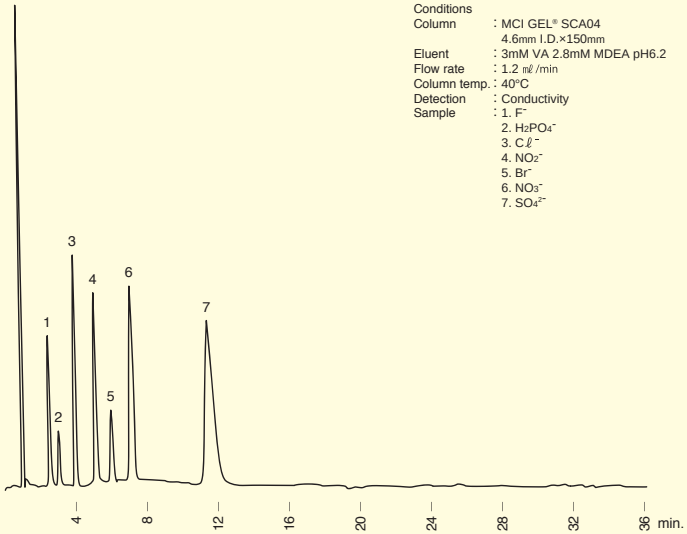
Fig. 3-11 Sports drink B



Conditions
Column : MCI GEL® SCK01 6mm I.D.×50mm
(On Fig. 3-8, two columns are connected in series)
Eluent : 2mM Tartaric acid, 1.5mM Ethylenediamine (Fig. 3-7, 3-9, 3-10, 3-11)
1.5mM Tartaric acid, 0.8mM Ethylenediamine (Fig. 3-8)
Flow rate : 1.0 mℓ/min
Column temp. : 40°C
Detection : Conductivity

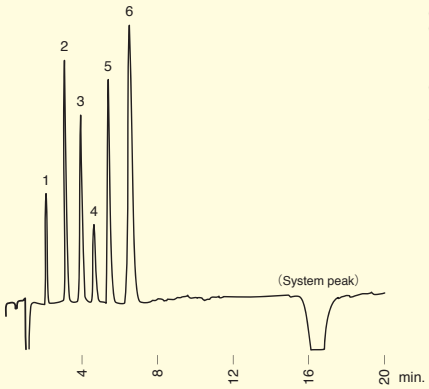
Application data of SCA04

Fig. 3-12 Standard anions eluent ; VA/MDEA



Conditions
Column : MCI GEL® SCA04
4.6mm I.D.×150mm
Eluent : 3mM VA 2.8mM MDEA pH6.2
Flow rate : 1.2 mℓ/min
Column temp. : 40°C
Detection : Conductivity
Sample : 1. F^-
2. $H_2PO_4^-$
3. $Cℓ^-$
4. NO_2^-
5. Br^-
6. NO_3^-
7. SO_4^{2-}

Fig. 3-13 Standard anions eluent ; Potassium hydrogenphthalate

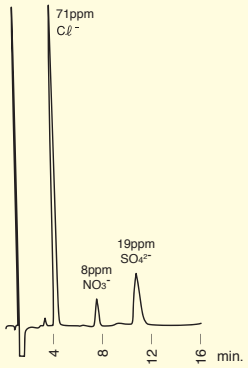


Conditions
Column : MCI GEL® SCA04
4.6mm I.D.×150mm
Eluent : 3mM KHP
Flow rate : 1.2 mℓ/min
Column temp. : 40°C
Detection : Conductivity
Sample : 1. F^-
2. $Cℓ^-$
3. NO_2^-
4. Br^-
5. NO_3^-
6. SO_4^{2-}

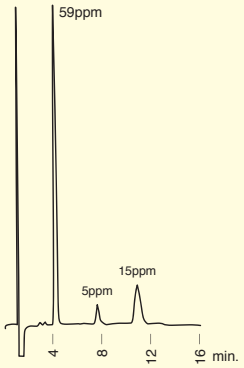
Application data of SCA04

Fig. 3-14 Rain

A; Beginning of rain fall



B; After 4 hours



C; After 38 hours

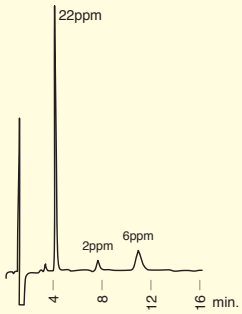
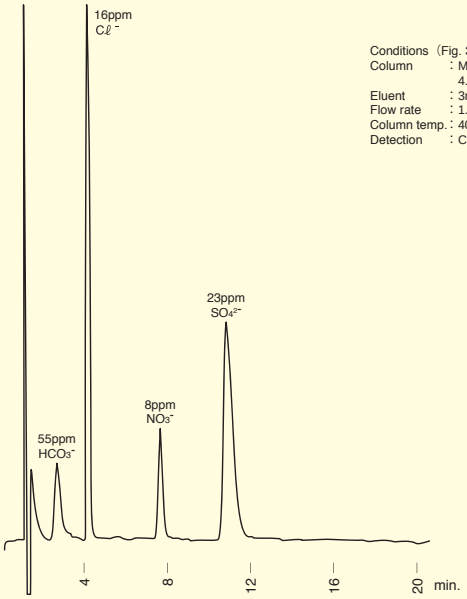


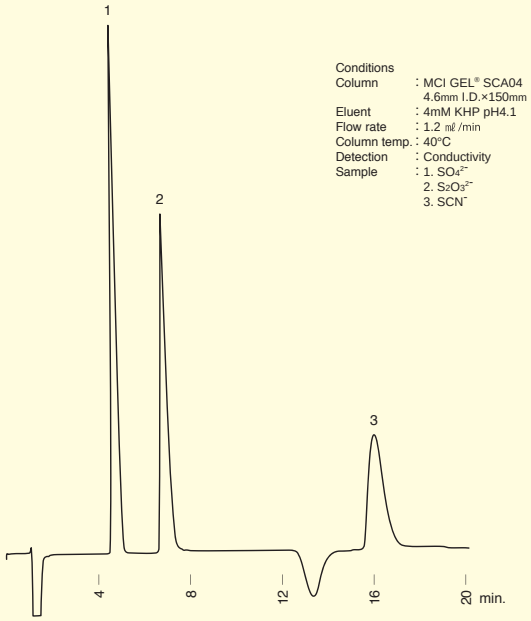
Fig. 3-15 River water



Conditions (Fig. 3-14, 3-15)
Column : MCI GEL® SCA04
4.6mm I.D.×150mm
Eluent : 3mM VA 2.8mM MDEA pH6.2
Flow rate : 1.2 mℓ/min
Column temp. : 40°C
Detection : Conductivity

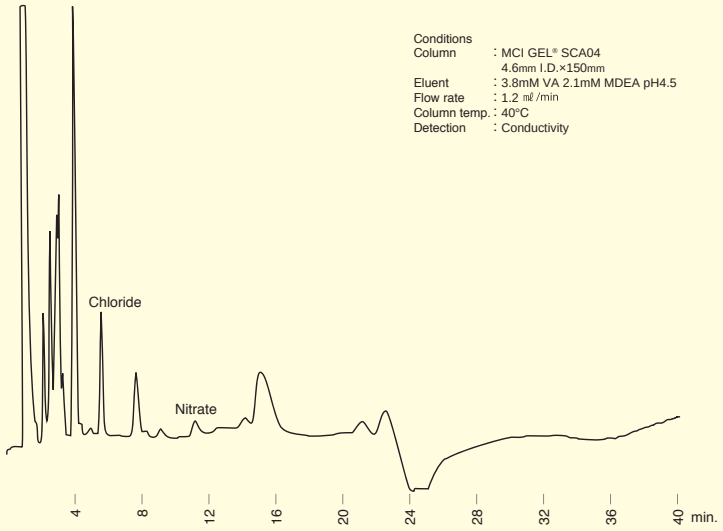
Application data of SCA04

Fig. 3-16 Sulfur compounds



Conditions
Column : MCI GEL® SCA04
4.6mm I.D.×150mm
Eluent : 4mM KHP pH4.1
Flow rate : 1.2 mℓ/min
Column temp. : 40°C
Detection : Conductivity
Sample : 1. SO_4^{2-}
2. $S_2O_3^{2-}$
3. SCN^-

Fig. 3-17 Instant coffee



Conditions
Column : MCI GEL® SCA04
4.6mm I.D.×150mm
Eluent : 3.8mM VA 2.1mM MDEA pH4.5
Flow rate : 1.2 mℓ/min
Column temp. : 40°C
Detection : Conductivity

4 MCI GEL®
Bioseparation columns and materials

- ○**Size exclusion chromatography columns**
  MCI GEL® CQP series
- ○**Ion exchange chromatography columns**
  MCI GEL® ProtEx series
  MCI GEL® CQA/CQK series
- ○**Hydrophobic interaction chromatography columns**
  MCI GEL® CQH series

Bioseparation columns

MCI GEL® bioseparation columns are based on a hydrophilic, wide pore and rigid polymer designed for analytical chromatography of proteins, peptides, enzymes and other biomolecules.

MCI GEL® CQP series are for size exclusion chromatography.

For ion exchange chromatography, MCI GEL® ProtEx series and MCI GEL® CQA/CQK series are used.
MCI GEL® ProtEx series columns are unique and brilliant packed columns provide excellent separation of proteins, good protein selectivity and high protein recovery. Specifically, proteins of small structural differences (isoforms) can be effectively separated and small amount of proteins (less than several tens μg) can be quantitatively recovered without nonspecific adsorption. From that point of view, the ProtEx columns can be applied in the field of purification of small amount of protein to obtain sample for structural determination and quality control of proteinaceous pharmaceuticals.

MCI GEL® CQH series are for hydrophobic interaction chromatography.

Column name	Separation mode	Type
MCI GEL® CQP06	Size exclusion	Exclusion limit MW ～10^3
MCI GEL® CQP10	Size exclusion	Exclusion limit MW ～10^4
MCI GEL® CQP30	Size exclusion	Exclusion limit MW ～10^6
MCI GEL® ProtEx-DEAE	Anion exchange	DEAE
MCI GEL® ProtEx-SP	Cation exchange	SP
MCI GEL® CQA31S	Anion exchange	DEAE
MCI GEL® CQA35S	Anion exchange	QA
MCI GEL® CQK30S	Cation exchange	SP
MCI GEL® CQK31S	Cation exchange	CM
MCI GEL® CQH3BS	Hydrophobic interaction	Butyl
MCI GEL® CQH3ES	Hydrophobic interaction	Ether
MCI GEL® CQH3PS	Hydrophobic interaction	Phenyl

CQP series
Aqueous size exclusion columns

Size exclusion chromatography columns

Size exclusion chromatography is a liquid chromatographic technique which separates solute molecules according to their size in solution. The column is packed with porous particles and separation takes place as a result of the differential solute distribution outside and within the pores of the packing material. Solute molecules which are larger than the pores of the packing material will be excluded and therefore will elute first and have a lower retention time than the smaller one. The CQP series columns based on a hydrophilic polymer are designed for analysis of water soluble polymers such as oligosaccharides and PEG, etc.

Column list

●CQP series

MCI GEL® column	Column dimensions	Packing materials		Theoretical plates number [TP／column]	Exclusion limit [PEG]
		Particle size[μm]	Pore size[nm]		
MCI GEL® CQP06	7.5mm I.D. ×600mm	10	12	10000	～$1×10^3$
MCI GEL® CQP10	7.5mm I.D. ×600mm	10	20	6000	～$1×10^4$
MCI GEL® CQP30	7.5mm I.D. ×600mm	10	60	6000	～$1×10^6$

●Guard columns

MCI GEL® column	Column dimensions
MCI GEL® CQP06G	4.0mm I.D.×50mm
MCI GEL® CQP10G	4.0mm I.D.×50mm
MCI GEL® CQP30G	4.0mm I.D.×50mm

●Packing materials

Packing materials are available. Please look at P.67.

Application data of CQP series

Fig. 4-1 Calibration curve

Conditions
Column : MCI GEL® CQP06
CQP10
CQP30
7.5mm I.D.×600mm
Eluent : H₂O
Flow rate : 1.0 mℓ/min
Column temp. : ambient
Detection : RI
Sample : PEG 100μl inj.

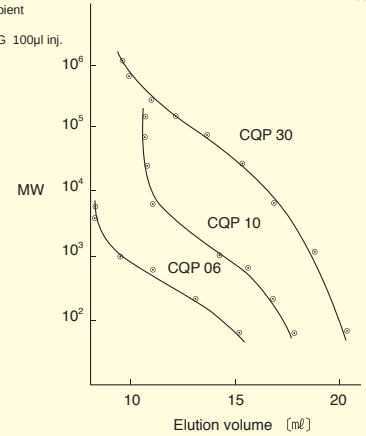


Fig. 4-2 Separation of PEG mixture

Conditions
Column : MCI GEL® CQP30 7.5mm I.D.×600mm
Eluent : H₂O
Flow rate : 1.0 mℓ/min
Column temp. : 25°C
Detection : RI
Sample : 1. PEG 145,000
2. 40,000
3. 6,000

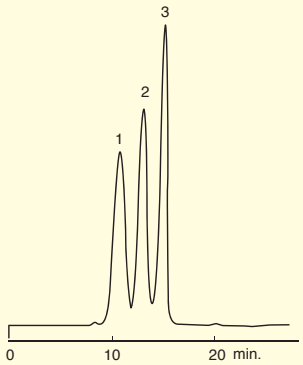


Fig. 4-3 Separation of protein mixture

Conditions
Column : MCI GEL® CQP30 7.5mm I.D.×600mm
Eluent : 14mM Tris-HCℓO₄ buffer
Flow rate : 1.0 mℓ/min
Column temp. : ambient
Detection : 280nm
Sample : 1. Ferritin (MW440,000)
2. Ovalbumin (MW43,000)
3. Myoglobin (MW17,500)
4. Cytochrome c (MW12,400)

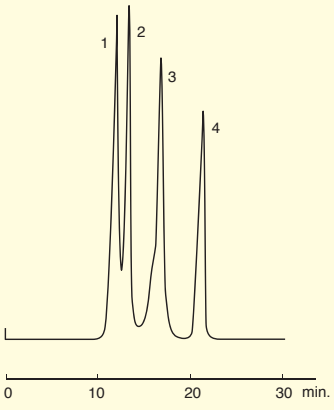
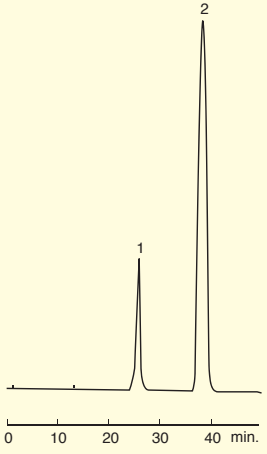


Fig. 4-4 Separation of gluconic acid and glucose

Conditions
Column : MCI GEL® CQP06 7.5mm I.D.×600mm
Eluent : H₂O
Flow rate : 0.8 mℓ/min
Column temp. : ambient
Detection : RI
Sample : 1. 5% Gluconic acid
2. 5% Glucose



4 MCI GEL®

ProtEx series

Ion exchange chromatography columns

ProtEx-DEAE 4.6×50 | ProtEx-SP 4.6×50 | ProtEx-DEAE 7.5×100 | ProtEx-SP 7.5×100

Separation mechanism and characteristic of ProtEx columns

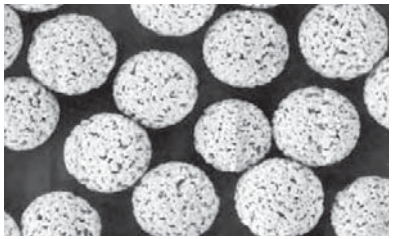
MCI GEL® ProtEx series packed columns are for ion exchange chromatography mode which separates sample proteins mainly via ionic interaction between packing material and sample molecules.
The packing materials for ProtEx series columns are based on 5 μm, mono disperse, porous type, methacrylate polymer, are specifically designed for separation of proteins.
On a conventional protein separation column, non-specific adsorption of sample proteins is sometimes occurs resulting in loss of valuable sample. But on the ProtEx columns, non-specific adsorption is eliminated because the surface of the packing material is surrounded by hydrophilic layer is chemically bonded to base material and ion exchange functional group are effectively increased.
Two types of ion exchange columns, weakly basic diethylaminoethyl (DEAE) type and strongly acidic sulfopropyl (SP) type are available.

Column list

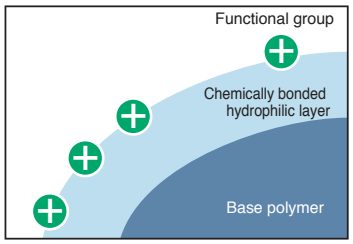
●ProtEx series

Column name	Column dimensions	Column format	Packing material		pH range
			Particle size [μm]	Functional group	
MCI GEL® ProtEx-DEAE	4.6mm I.D.× 50mm	PEEK	5	Diethylaminoethyl	2～12
	7.5mm I.D.×100mm	PEEK	5	Diethylaminoethyl	2～12
MCI GEL® ProtEx-SP	4.6mm I.D.× 50mm	PEEK	5	Sulfopropyl	1～13
	7.5mm I.D.×100mm	PEEK	5	Sulfopropyl	1～13

Packing material of ProtEx-DEAE



Scanning electron micrograph



Surface of ProtEx-DEAE

Fig. 4-5 Separation of proteins mixture

Conditions
Column : MCI GEL® ProtEx-DEAE 4.6mm I.D.×50mm
Eluent : A 20mM Tris-HCl pH8.0
B A+0.5M NaCl
A → B 30min linear gradient
Flow rate : 0.5 mℓ/min
Column temp. : ambient
Detection : 280nm
Sample : 1. Myoglobin 25μg
2. Conalbumin 25μg
3. Trypsin Inhibitor 50μg

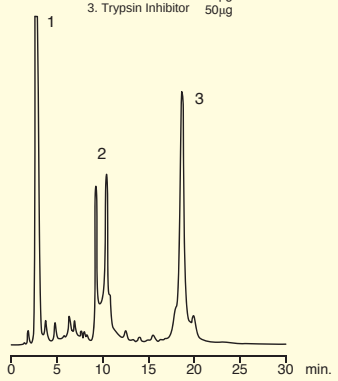


Fig. 4-6 Separation of hemoglobin (Hb) isoforms

Conditions
Column : MCI GEL® ProtEx-DEAE 4.6mm I.D.×50mm
Eluent : A 20mM Tris-HCl pH8.0
B A+0.5M NaCl
A → 10% B 30min linear gradient
Flow rate : 0.5 mℓ/min
Column temp. : ambient
Detection : 280nm
Sample : 1. Hb A_2 100μg
2. Hb S 100μg
3. Hb A0 100μg

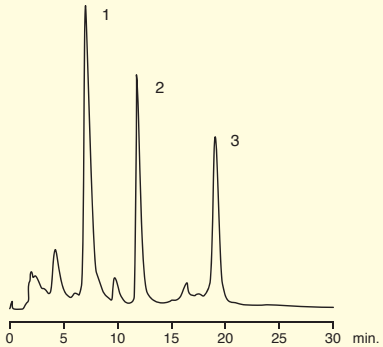


Fig. 4-7 Separation of human growth hormone (hGH)

Conditions
Column : MCI GEL® ProtEx-DEAE 4.6mm I.D.×50mm
Eluent : A 20mM Tris-HCl pH8.0
B A+0.5M NaCl
: 5% B → 70% B 30min linear gradient
Flow rate : 0.5 mℓ/min
Column temp. : ambient
Detection : 280nm
Sample : recombinant hGH 10μg

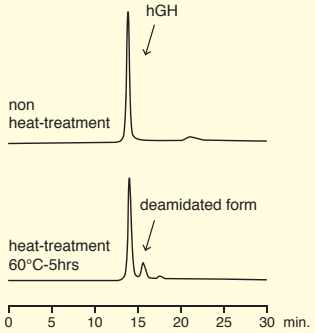


Fig. 4-8 Protein recovery

Conditions
Column : MCI GEL® ProtEx-DEAE 4.6mm I.D.×50mm
Eluent : A 20mM Tris-HCl pH8.15
B A+0.5M NaCl
A → 50% B 30min linear gradient
Flow rate : 0.5 mℓ/min
Column temp. : ambient
Detection : 280nm
Sample : recombinant epidermal growth factor (EGF)

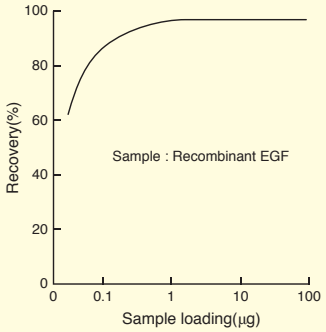


Fig. 4-9 Separation of interleukin 2 (IL-2) coexisting large amount of bovine serum albumin (BSA) as a stabilizer

Conditions
Column : MCI GEL® ProtEx-DEAE 4.6mm I.D.×50mm
Eluent : A 20mM Trimethylenediamine-HCl pH9.75
B A+0.5M NaCl
Flow rate : 0.5 mℓ/min
Column temp. : ambient
Detection : 280nm
Sample : recombinant IL-2 1.5μg
1. BSA (stabilizer) 400μg
2. IL-2 (Met-ox)
3. IL-2

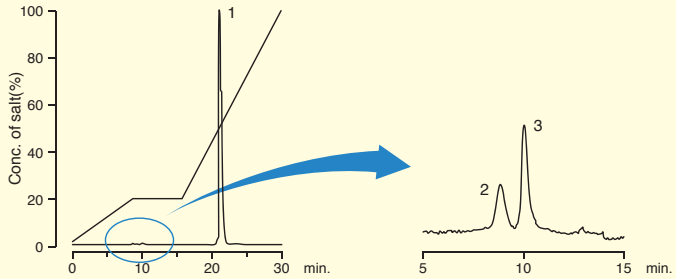


Fig. 4-10 Separation of protein mixture

Conditions
Column : MCI GEL® ProtEx-SP 4.6mm I.D.×50mm
Eluent : A 20mM Phosphate buffer pH6.0
B A+0.5M NaCl
A → B 20min linear gradient
Flow rate : 0.5 mℓ/min
Column temp. : ambient
Detection : 280nm
Sample : 1. Ribonuclease A 10μg
2. α-Chymotrypshinogen A 5μg
3. Cytochrome C 5μg

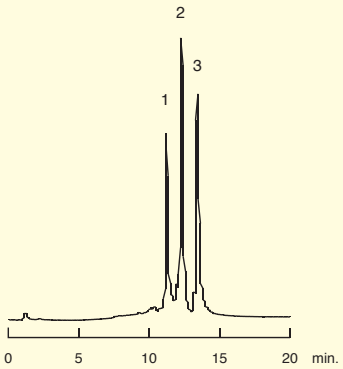


Fig. 4-11 Separation of glycohemoglobin (GHb)

Conditions
Column : MCI GEL® ProtEx-SP 4.6mm I.D.×50mm
Eluent : A 20mM Bis-Tris HCl buffer pH6.0
B A+0.5M NaCl
7% B → 40% B 20min linear gradient
Flow rate : 0.5 mℓ/min
Column temp. : ambient
Detection : 415nm
Sample : GHb
1. GHb A1c
2. Hb A0

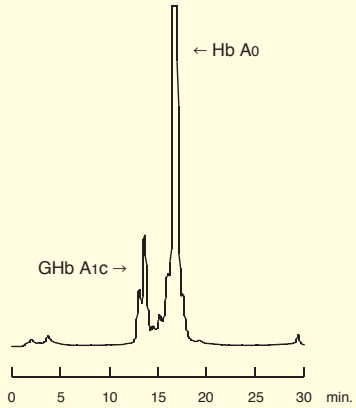


Fig. 4-12 Separation of mouse brain sap

Conditions
Column : MCI GEL® ProtEx-DEAE 4.6mm I.D.×50mm
Eluent : A 20mM HEPES buffer pH8.0
B A+0.1M NaCl
A100% → B100% in 60min. linear gradient
Flow rate : 0.5 mℓ/min
Column temp. : 25°C
Detection : 280nm
Sample : Mouse brain sap

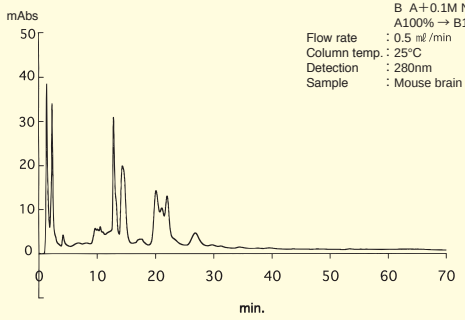


fig4-12

Fig. 4-13 Separation of RNA

Conditions
Column : MCI GEL® ProtEx-DEAE 4.6mm I.D.×50mm
Eluent : A 20mM Phosphate buffer pH7.0
B A+0.5M NaCl
A100% → B60% in 5min. B60% → B85% in 45min
Flow rate : 0.5 mℓ/min
Column temp. : 25°C
Detection : 280nm
Sample : RNA type III from bakers yeast 20µg

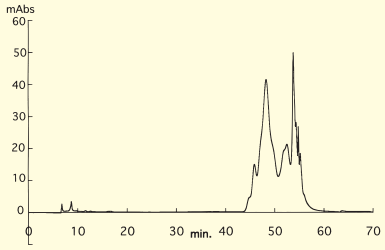


fig4-13

Fig. 4-14 Separation of IgG2b, *K*(mouse)

Conditions
Column : MCI GEL® ProtEx-DEAE 4.6mm I.D.×50mm
Eluent : A 20mM HEPES buffer pH7.6
B A+0.5M NaCl
A100% → B45% in 30min. B45% for 5min
B45% → B100% in 5min. B100% for 10min
Flow rate : 0.5 mℓ/min
Column temp. : 25°C
Detection : 280nm
Sample : IgG2b, κ(mouse) 10µg

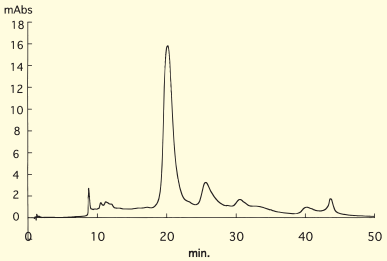


fig4-14

Fig. 4-15 Separation of collagenase

Conditions
Column : MCI GEL® ProtEx-DEAE 4.6mm I.D.×50mm
Eluent : A 20mM HEPES buffer pH8.0
B A+1.0M NaCl
A100% → B100% in 30min. linear gradient
Flow rate : 0.5 mℓ/min
Column temp. : 25°C
Detection : 280nm
Sample : Collagenase 100µg

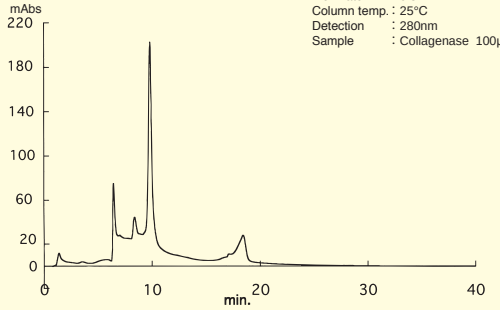


fig4-15

Fig. 4-16 Separation of IgG1 MOPC21 (mouse)

Conditions
Column : MCI GEL® ProtEx-DEAE 4.6mm I.D.×50mm
Eluent : A 10mM HEPES buffer pH8.0
B A+0.5M NaCl
A100% → B100% in 30min. linear gradient
Flow rate : 0.5 mℓ/min
Column temp. : 25°C
Detection : 280nm
Sample : IgG1 MOPC21 (mouse) 10µg

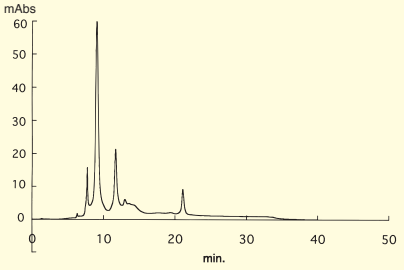


fig4-16

Fig. 4-17 Separation of pancreatin

Conditions
Column : MCI GEL® ProtEx-DEAE 4.6mm I.D.×50mm
Eluent : A 20mM HEPES buffer pH8.0
B A+1.0M NaCl
A100% → B40% in 30min. linear gradient
Flow rate : 0.5 mℓ/min
Column temp. : 25°C
Detection : 280nm
Sample : Pancreatin 200µg

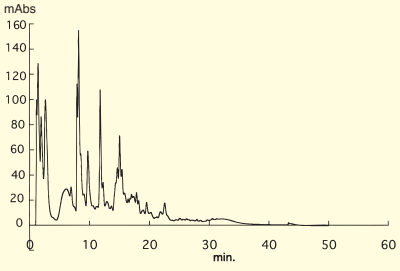


fig4-17

CQA series CQK series

Ion exchange chromatography columns

CQA and CQK series packed columns are for ion exchange chromatography mode which separates sample proteins mainly via ionic interaction between packing material and sample molecules.
Four types of ion exchange columns, strongly basic quaternary ammonium (QA), weakly basic diethylaminoethyl (DEAE), strongly acidic sulfopropyl (SP) and weakly acidic carboxymethyl (CM) are available.

Column list

●CQA series, CQK series

Column name	Column dimensions	Packing material		pH range
		Particle size [μm]	Functional group	
MCI GEL® CQA31S	7.5mm I.D.×75mm	10	DEAE	2～12
MCI GEL® CQA35S	7.5mm I.D.×75mm	10	QA	2～12
MCI GEL® CQK30S	7.5mm I.D.×75mm	10	SP	1～13
MCI GEL® CQK31S	7.5mm I.D.×75mm	10	CM	4～13

●Packing materials

Packing materials are available. Please look at P.68.

Application data of CQA and CQK series

Fig. 4-18 Separation of protein mixture

Conditions
Column : MCI GEL® CQA31S 7.5mm I.D.×75mm
MCI GEL® CQA35S 7.5mm I.D.×75mm
Eluent : A 14mM Tris-HCl buffer pH8.2
B A +0.5M NaCl
A → B 30min linear gradient
Flow rate : 1.0 mℓ/min
Column temp. : ambient
Detection : 280nm
Sample : 1. Myoglobin 60μg
2. Ovalbumin 200μg
3. Trypsin Inhibitor 200μg

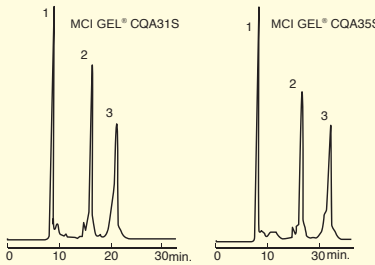
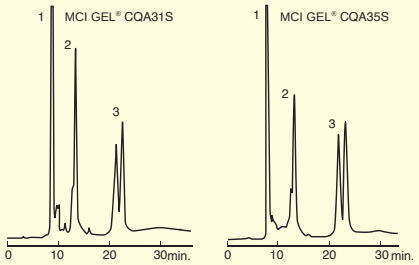


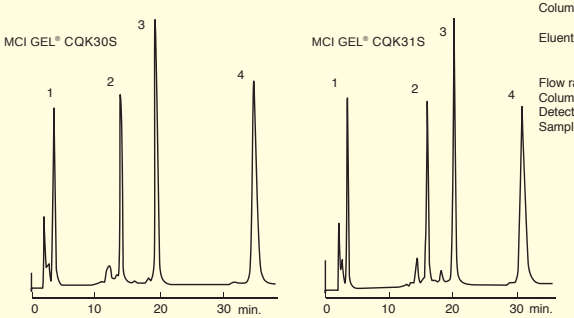
Fig. 4-19 Separation of protein mixture

Conditions
Column : MCI GEL® CQA31S 7.5mm I.D.×75mm
MCI GEL® CQA35S 7.5mm I.D.×75mm
Eluent : A 14mM Tris-HCl buffer pH8.2
B A +0.5M NaCl
A → B 30min linear gradient
Flow rate : 1.0 mℓ/min
Column temp. : ambient
Detection : 280nm
Sample : 1. Myoglobin 120μg
2. Transferrin 160μg
3. β -Lactoglobulin 400μg



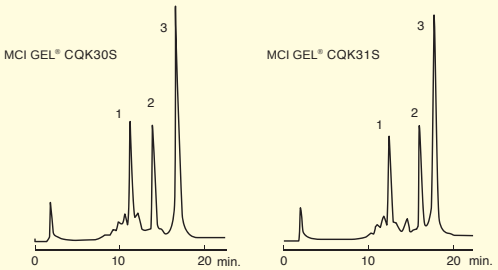
Application data of CQA and CQK series

Fig. 4-20 Separation of protein mixture



Conditions
Column : MCI GEL® CQK30S 7.5mm I.D.×75mm
MCI GEL® CQK31S 7.5mm I.D.×75mm
Eluent : A 20mM Phosphate buffer pH6.8
B A +0.5M NaCl
A → B 30min linear gradient
Flow rate : 1.0 mℓ/min
Column temp. : ambient
Detection : 280nm
Sample : 1. Myoglobin 50μg
2. Ribonuclease A 200μg
3. Cytochrome C 60μg
4. Lysozyme 80μg

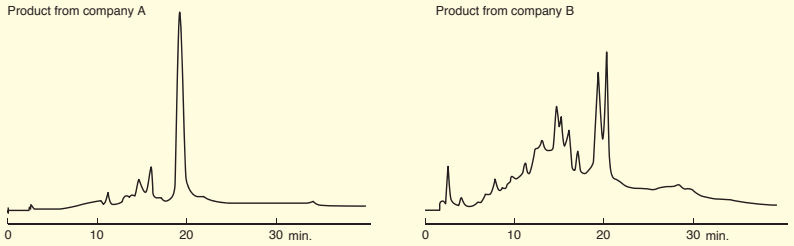
Fig. 4-21 Separation of protein mixture



Conditions
Column : MCI GEL® CQK30S 7.5mm I.D.×75mm
MCI GEL® CQK31S 7.5mm I.D.×75mm
Eluent : A 20mM Phosphate buffer pH6.8
B A +0.5M NaCl
A → B 30min linear gradient
Flow rate : 1.0 mℓ/min
Column temp. : ambient
Detection : 280nm
Sample : 1. Trypsinogen 80μg
2. Ribonuclease A 90μg
3. α -Chymotrypsinogen A 60μg

Fig. 4-22 Separation of lipoxidase

Conditions
Column : MCI GEL® CQA31S 7.5mm I.D.×75mm
Eluent : A 14mM Tris-HCl buffer pH8.2
B A +0.5M NaCl
A → B 30min linear gradient
Flow rate : 1.0 mℓ/min
Column temp. : ambient
Detection : 280nm
Sample : Lipoxidase



CQH series

Hydrophobic interaction chromatography columns

MCI GEL® CQH series packed columns are for hydrophobic chromatography mode. Functional groups of the packing materials are butyl, phenyl and ether.
The relative hydrophobicity of the CQH series columns decrease in the following order. CQH3PS > CQH3BS > CQH3ES.

Chromatography column and material list

●CQH_S series

MCI GEL® CQH_S series are for analytical chromatography columns and materials for separating biomolecules in the basis of difference of their hydrophobic properties. Average particle size is 10 µm.

＜Column list＞

Column name	Column dimensions	Particle size [µm]	Functional group
MCI GEL® CQH3BS	7.5mm I.D.×75mm	10	Butyl
MCI GEL® CQH3ES	7.5mm I.D.×75mm	10	Ether
MCI GEL® CQH3PS	7.5mm I.D.×75mm	10	Phenyl

＜Packing material list＞

Material name	Particle size [µm]	Functional group
MCI GEL® CQH3BS	10	Butyl
MCI GEL® CQH3ES	10	Ether
MCI GEL® CQH3PS	10	Phenyl

●CQH_P series

MCI GEL® CQH3BP and CQH3PP are for preparative chromatography materials for separating biomolecules in the basis of difference of their hydrophobic properties. Average particle size is 30 µm.
The relative hydrophobicity of the CQH_P series columns decrease in the following order.
CQH3PP > CQH3BP.
The chromatographic characteristics of CQH_S series and CQH_P sereies are same, so experimental results of separating conditions of CQH_S series can be applied to CQH_P series.

＜Packing material list＞

Material name	Particle size [µm]	Functional group
MCI GEL® CQH3BP	30	Butyl
MCI GEL® CQH3PP	30	Phenyl

Application data of CQH series

Fig. 4-23 Separation of human serum

Conditions
Column : MCI GEL® CQH3ES 7.5mm I.D.×75mm
MCI GEL® CQH3PS 7.5mm I.D.×75mm
Eluent : A B+1.7M$(NH_4)_2SO_4$
B 0.1M Phosphate buffer pH6.8
A → B 60min linear gradient
Flow rate : 1mℓ/min
Column temp. : ambient
Detection : 280nm
Sample : Human serum

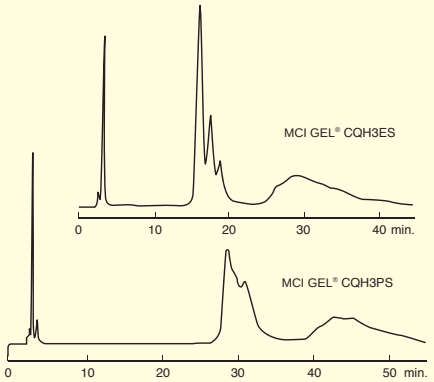


Fig. 4-24 Separation of colibacillus extract

Conditions
Column : MCI GEL® CQH3ES 7.5mm I.D.×75mm
Eluent : A B+1.7M$(NH_4)_2SO_4$
B 0.1M Phosphate buffer pH6.8
A → B 30min linear gradient
Flow rate : 1.0 mℓ/min
Column temp. : ambient
Detection : 280nm
Sample : Colibacillus extract

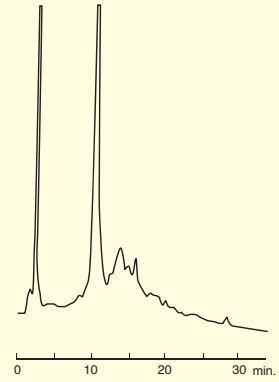


Fig. 4-25 Separation of colibacillus extract

Conditions
Column : MCI GEL® CQH3PS 7.5mm I.D.×75mm
Eluent : A B+1.7M$(NH_4)_2SO_4$
B 0.1M Phosphate buffer pH6.8
A → B 30min linear gradient
Flow rate : 1.0 mℓ/min
Column temp. : ambient
Detection : 280nm
Sample : Colibacillus extract

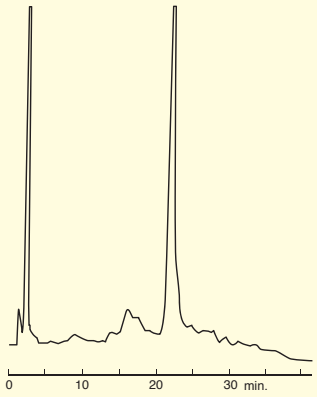
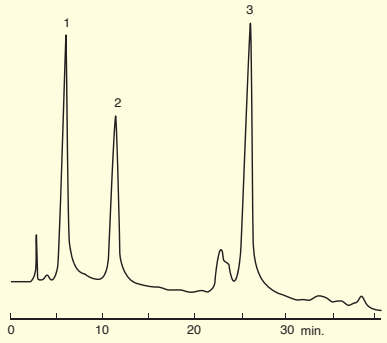


Fig. 4-26 Separation of mixture of peptides

Conditions
Column : MCI GEL® CQH3PS 7.5mm I.D.×75mm
Eluent : A B+1.7M$(NH_4)_2SO_4$
B 0.1M Phosphate buffer pH6.8
A → B 30min linear gradient
Flow rate : 1.0 mℓ/min
Column temp. : ambient
Detection : 220nm
Sample : 1. Met-Leu-Tyr
2. Leu-Enkephalin
3. Bacitracin



Application data of CQH series

Fig. 4-27 Proteins

Conditions
Column : CQH3BS, 7.5mmI.D.×75mmL
CQH3BP, 7.5mmI.D.×75mmL
Eluent : A : B+1.7M $(NH_4)_2SO_4$
B : 0.1M Phosphate buffer (pH6.8)
Gradient : A→B, 30min, linear
Flow rate : 1.0 mℓ/min
Column temp. : 25°C
Detection : 280nm,
Sample : 1. Ribonuclease A 112μg
2. Transferrin 154μg
3. α-Chymotrypsinogen A 60μg

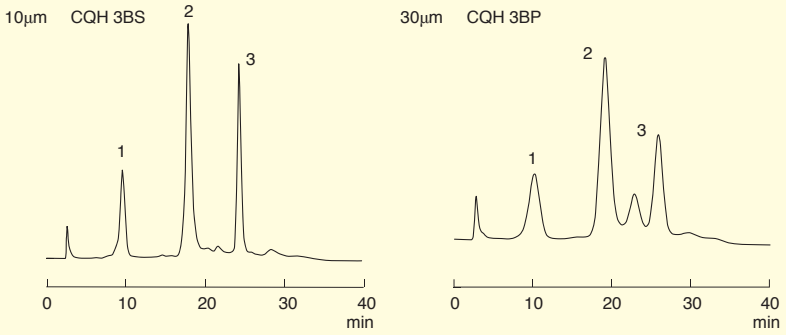
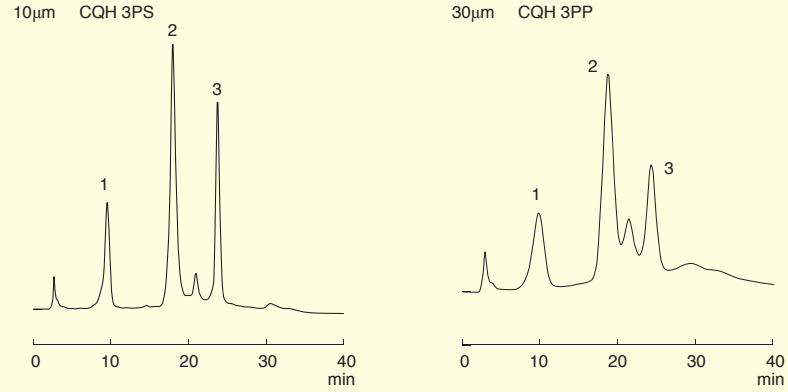


Fig. 4-28 Proteins

Conditions
Column : CQH3PS, 7.5mm I.D.×75mmL
CQH3PP, 7.5mm I.D.×75mmL
Eluent : A : B+1.7M $(NH_4)_2SO_4$
B : 0.1M Phosphate buffer (pH6.8)
Gradient : A→B, 30min, linear
Flow rate : 1.0 mℓ/min
Column temp. : 25°C
Detection : 280nm,
Sample : 1. Ribonuclease A 112μg
2. Transferrin 154μg
3. α-Chymotrypsinogen A 60μg



5 MCI GEL®
Analytical and preparative chromatography columns and materials for pharmaceutical applications

○Polymeric reversed-phase chromatography columns and materials MCI GEL® CHP series

Polymeric reversed-phase separation mechanism of CHP series

A partition chromatography, an adsorption chromatography, an ion exchange chromatography and a size exclusion chromatography are typical separation mechanisms of high performance liquid chromatography. The partition chromatography is most commonly used, separates solute samples in accordance with the difference of partition of the samples between a stationary phase and a mobile phase, can be applied to broad range of applications of organic compounds such as pharmaceuticals, agricultural chemicals and those intermediate substances. There are two separation mechanisms in the partition chromatography, one is a normal phase and the other is a reversed phase are discriminated by comparison of polarity of stationary phase and mobile phase. On the normal phase chromatography, a polarity of the stationary phase is stronger than that of the mobile phase. As for the reversed-phase (RP) mode, the relationship of the polarities of the two phases reverses. The RP chromatography is the most popular separation mode is said that RP occupies 60-70 % of HPLC applications.

MCI GEL® specializes in polymer based packing materials. The use of polymeric based RP columns has become more widespread thanks to unique selectivity of the polymer matrix, no specific adsorption common with silica based packings and can be operated with a wide pH range, basic eluents and acidic eluents due to the chemical stability of the inert polymeric materials. The MCI GEL® reversed-phase columns are based on a polystyrenic and polymethacrylate porous polymers are normally applied to the separation of aromatic and aliphatic based compounds in the isocratic and gradient elution modes. The applications include pharmaceuticals, steroids, small peptides, amphoteric molecules such as sulfonamides and cephalosporin antibiotics, plus basic drugs, simple amines, antihistamines and carbamate pesticides.

The MCI GEL® reversed-phase packing materials are based on the same chemistries offered in the Diaion® and Sepabeads® synthetic adsorbents resins. These polymer chemistries, like Diaion® HP series and Sepabeads® SP series are widely used and documented in the biopharmaceutical industry for fermentation extraction, the food industry and industrial reversed phase separations. The MCI GEL® reversed-phase packing materials are available as packed columns for analytical applications and as bulk packings for analytical, preparative and production chromatography applications.

●Description of reversed-phase chromatography columns and materials

MCI GEL® CHP20/C04

- CHP20 — Matrix type
- C04 — Particle size
- C = Column
- P = Material

CHP column series

Polymeric reversed-phase chromatography columns

MCI GEL® CHP column series are suitable for reversed-phase chromatography and there are four kinds of columns of various hydrophobicity; Porous polystyrene, Modified Porous polystyrene, Polymethacrylates and Octadecyl-alkylated aliphatic Porous polymers. Thus proper kind of columns can be selected in accordance with the properties of the target compounds.

Polystyrene packing	: MCI GEL® CHP20/C04, CHP20/C10
Modified polystyrene packing	: MCI GEL® CHP07/C04, CHP07/C10
Polymethacrylates packing	: MCI GEL® CMG20/C04, CMG20/C10
Octadecyl-alkylated aliphatic packing	: MCI GEL® CHPOD/C04

The hydrophobicities of the columns are in the following order:

MCI GEL® CHP07/C04=CHP07/C10 > CHP20/C04=CHP20/C10 > CHPOD/C04 ≧ ODS columns ≧ CMG20/C04=CMG20/C10

Polymer columns for HPLC, with superior chemical resistance, can be applied with various mobile phases of broad pH range, acidic through alkaline. They have the following advantages due to their high hydrophobicity:

1) In the reversed phase distribution chromatography to separate acidic or alkaline compounds, the eluents suppressing the ionic properties of such compounds are generally used. Polymer columns can be applied for the unsuitable compounds to ODS columns.
2) Some of high hydrophilic compounds, e.g. amino acids, can be separated with strong hydrophobic CHP07/C04 and CHP07/C10 column.
3) Polymer columns can be washed with acidic and/or basic solutions when deteriorated by contamination.

Polymethacrylates, CMG20/C04 and CMG20/C10, can be applied not only for reversed phase distribution chromatography but also for normal phase one.

CHP20/C04 4.6×150

CHP20/C10 4.6×250

CMG20/C04 4.6×150

Column list

●CHP column series

Matrix Type	Product name	Old name	Particle size [μm]	Column size [mm I.D.×mm]	pH range
Styrene Divinylbenzene	CHP20/C04	CHP10M	4	4.6×150 20×150	Whole range
	CHP20/C10	NEW	10	4.6×250 10×250 20×150 20×250	Whole range
Brominated Styrene Divinylbenzene	CHP07/C04	CHP207M	4	4.6×150 20×200	Whole range
	CHP07/C10	CHP207S	10	4.6×250 10×150 20×150 20×250	Whole range
Methacrylates	CMG20/C04	CHP2MGM	4	4.6×150 20×150	2～12
	CMG20/C10	CHP2MG	10	4.6×250 10×250 20×150 20×250	2～12
C18-alkylated aliphatics	CHPOD/C04	CHPOD1M	4	4.6×150 20×200	2～12

＊CHP5C is abolished and substitute is CHP20/C10.

Durability of polymeric column

The polymeric RP columns are chemically stable. Specifically, the columns have resistance to an alkaline eluent. The following graphs demonstrate stability of the polymeric columns. After feeding a solution of pH 12 into the MCI GEL® CHP20/C04, there is no change of column performance.

Fig. 5-1 Column durability at pH12 comparison between CHP20/C04 and an ODS column

Conditions
Column : MCI GEL® CHP20/C04 4.6mmI.D × 150mm
Eluent : 20mM Na_2HPO_4 pH12/CH3CN/=60/40
Flow rate : 0.4㎖/min
Column temp. : 25°C
Detection : 254nm
Sample : 1000ppm Dimethyl phthalate 5μL

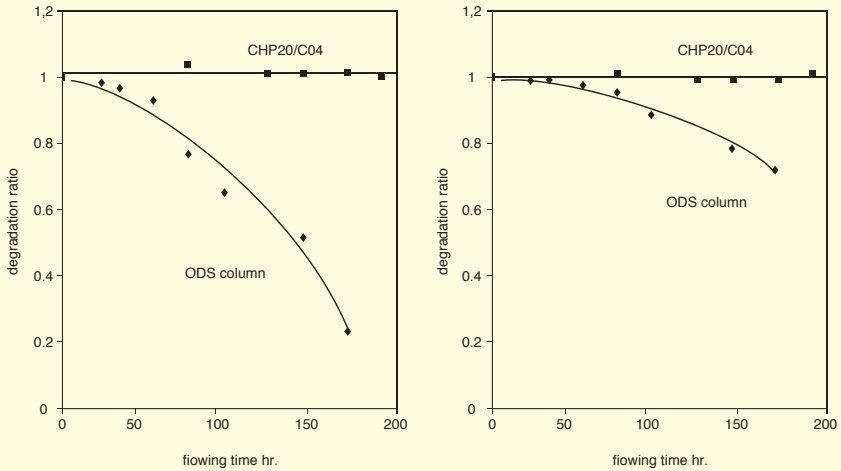
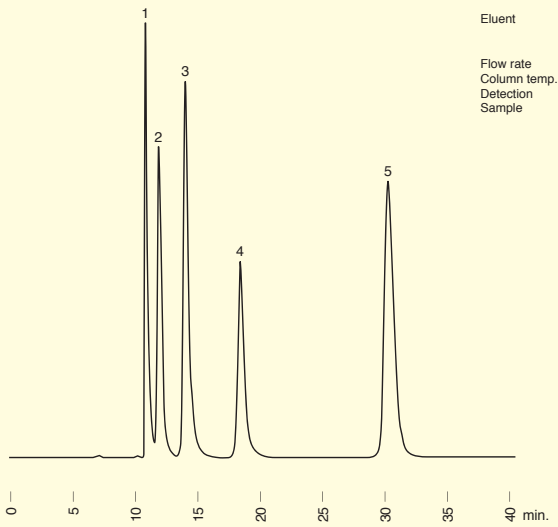
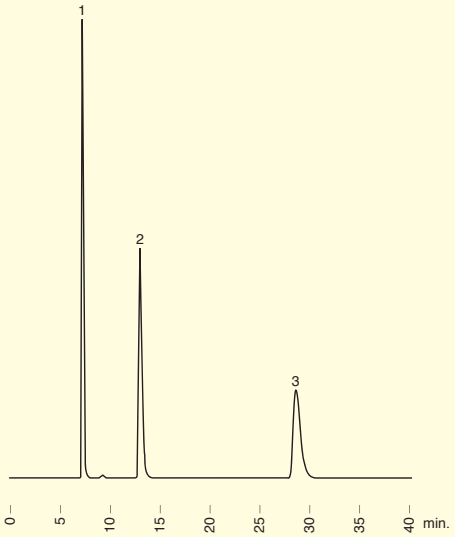


Fig. 5-2 Separation of catecholamines



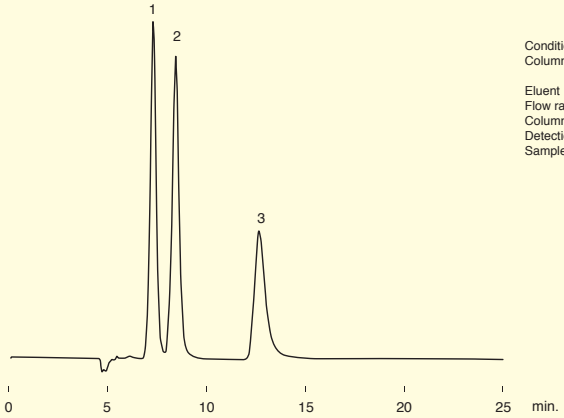
Conditions
Column : MCI GEL® CHP20/C04
4.6mm I.D.×150mm
Eluent : 50mM Na-phosphate pH2.0,
1.5% Hexanesulfonic acid /
CH_3CN=80/20
Flow rate : 0.25 mℓ/min
Column temp. : ambient
Detection : 280nm
Sample : 1. Epinephrine
2. Dopamine
3. 5-Hydroxy tryptophan
4. Serotonin
5. Tryptophan

Fig. 5-3 Separation of phthalic acid esters



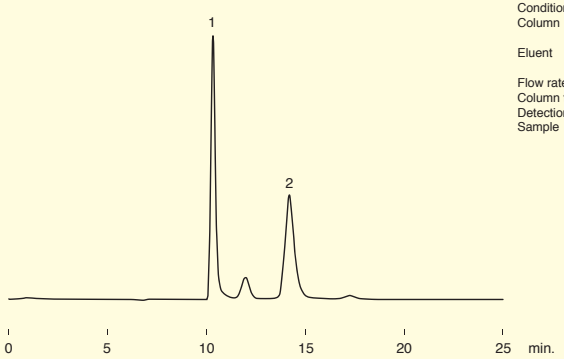
Conditions
Column : MCI GEL® CHP20/C04
4.6mm I.D.×150mm
Eluent : H_2O/CH_3CN=50/50
Flow rate : 0.75 mℓ/min
Column temp. : 60°C
Detection : 254nm
Sample : 1. Dimethyl phthalate
2. Diethyl phthalate
3. Dipropyl phthalate

Fig. 5-4 Purine alkaloids



Conditions
Column : MCI GEL® CHP20/C04
4.6mm I.D.×150mm
Eluent : H_2O/CH_3CN=10/90
Flow rate : 0.4 mℓ/min
Column temp. : 25°C
Detection : 275nm
Sample : 1.Theophylline
2.Theobromine
3.Caffeine

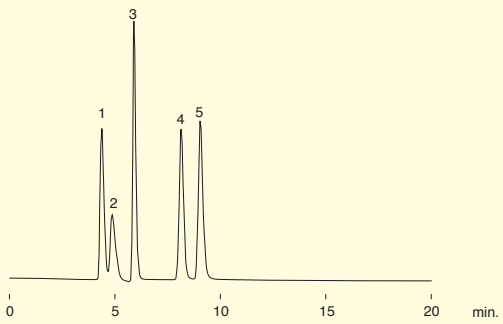
Fig. 5-5 Cinchona alkaloids



Conditions
Column : MCI GEL® CHP20/C04
4.6mm I.D.×150mm
Eluent : 0.1M NaH_2PO_4 pH2.0
CH_3CN=88/12
Flow rate : 0.3 mℓ/min
Column temp. : 25°C
Detection : 275nm
Sample : 1.Cinchonine
2.Quinine

Application data of CHP series

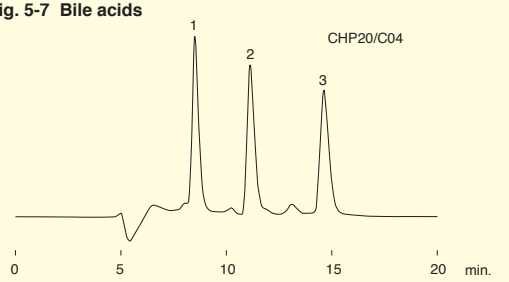
Fig. 5-6 Uric acid and related compounds



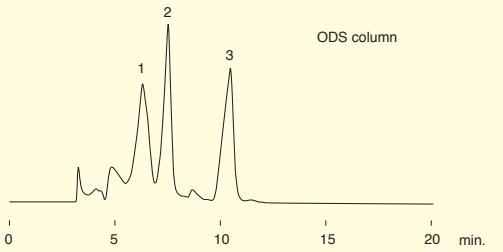
Conditions
Column : MCI GEL® CHP20/C04 4.6mm I.D.×150mm
Eluent : 10mM TBA/CH3CN=75/25
Flow rate : 0.4 mℓ/min
Column temp. : 25°C
Detection : 284nm
Sample : 1.Hypoxanthine 2.Xanthine 3.Theophylline 4.Uric acid 5.Orotic acid

Comparison with an ODS column

Fig. 5-7 Bile acids



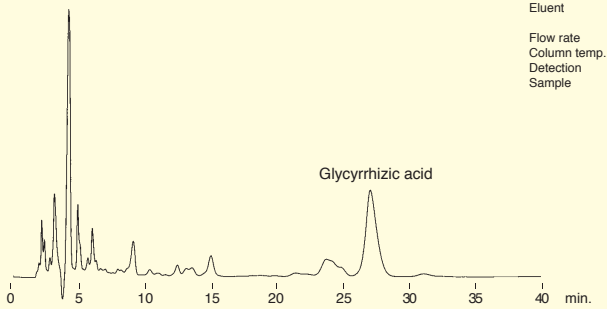
Conditions
Column : MCI GEL® CHP20/C04 4.6mm I.D.×150mm
Eluent : 50mM NaH_2PO_4 pH2.0 /CH_3CN=40/60
Flow rate : 0.3 mℓ/min
Column temp. : 25°C
Detection : 210nm
Sample : 1.Cholic acid 2.Ursodeoxycholic acid 3.Deoxycholic acid



Conditions
Column : ODS column (5μm) 4.6mm I.D.×150mm
Eluent : 50mM NaH_2PO_4 pH6.0 /CH_3CN=40/60
Flow rate : 0.3 mℓ/min
Column temp. : 25°C
Detection : 210nm
Sample : 1.Cholic acid 2.Ursodeoxycholic acid 3.Deoxycholic acid

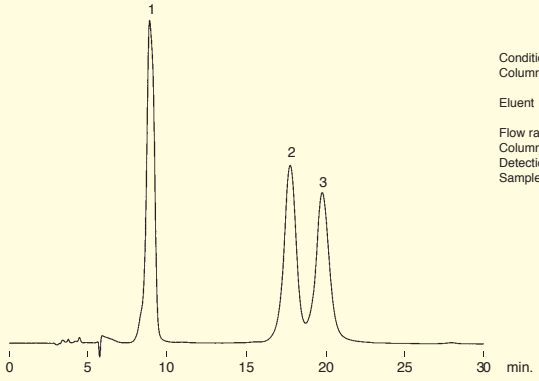
Application data of CHP series

Fig. 5-8 Glycyrrhizae radix



Conditions
Column : MCI GEL® CHP20/C04 4.6mm I.D.×150mm
Eluent : 2.06% acetic acid/CH_3CN =63/37
Flow rate : 0.5 mℓ/min
Column temp. : 45°C
Detection : 254nm
Sample : Extract of glycyrrhizae radix

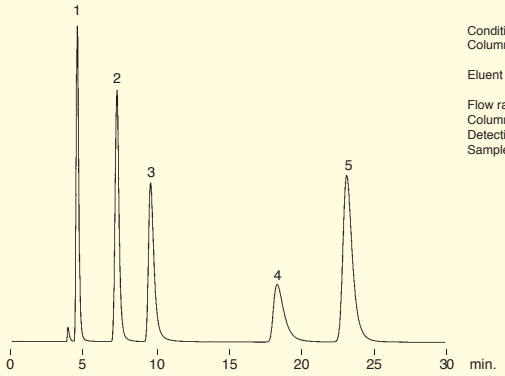
Fig. 5-9 Adrenal cortex hormones



Conditions
Column : MCI GEL® CHP20/C04 4.6mm I.D.×150mm
Eluent : H_2O/CH_3CN : 60/40
Flow rate : 0.5 mℓ/min
Column temp. : 45°C
Detection : 280nm
Sample : 1.Hydrocortisone 2.Corticosterone 3.11-Deoxycortisol

Application data of CHP series

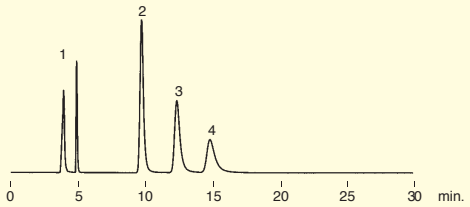
Fig. 5-10 Ingredients of medicine



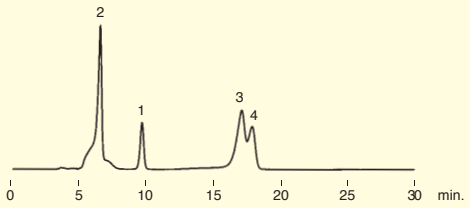
Conditions
Column : MCI GEL® CMG20/C04
4.6mm I.D.×150mm
Eluent : 50mM phosphoric acid(pH2.0)/CH_3OH
=60/40
Flow rate : 0.5 mℓ/min
Column temp. : 45°C
Detection : 254nm
Sample : 1.4-Dimethylaminoantipyrine
2.Antipyrine
3.Caffeine
4.Aspirin
5.Phenacetin

Comparison with an ODS column

Fig. 5-11 Sulfa drugs



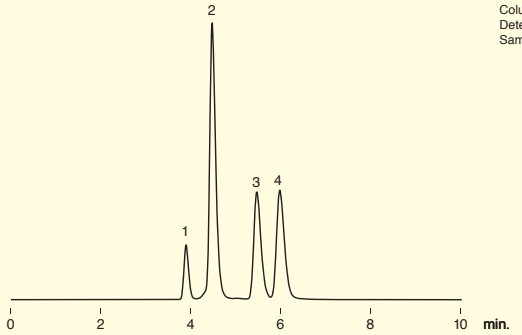
Conditions
Column : MCI GEL® CMG20/C04
4.6mm I.D.×150mm
Eluent : 20mM phosphate pH6.8/CH_3CN
=82/18
Flow rate : 0.5 mℓ/min
Column temp. : 45°C
Detection : 254nm
Sample : 1.Succinylsulfathiazole
2.Sulfanilamide
3.Sulfathiazole
4.Sulfamerazine



Conditions
Column : ODS column
4.6mm I.D.×150mm
Eluent : 20mM phosphate pH6.8/CH_3CN
=90/10
Flow rate : 0.5 mℓ/min
Column temp. : 45°C
Detection : 254nm
Sample : 1.Succinylsulfathiazole
2.Sulfanilamide
3.Sulfathiazole
4.Sulfamerazine

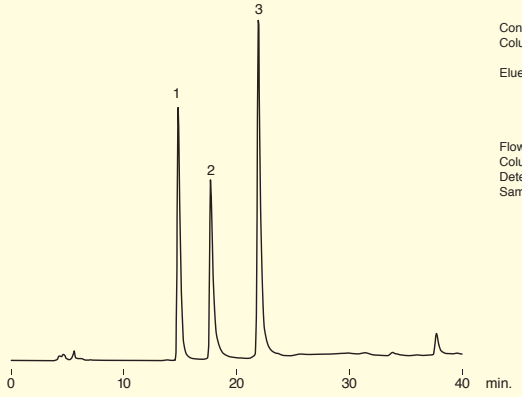
Application data of CHP series

Fig. 5-12 Peptides



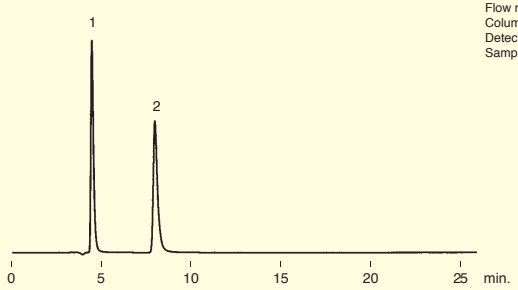
Conditions
Column : MCI GEL® CMG20/C04
4.6mm I.D.×150mm
Eluent : 0.1%TFA/CH_3CN
=70/30
Flow rate : 0.5 mℓ/min
Column temp. : 25°C
Detection : 220nm
Sample : 1.Gly-Tyr
2.Met Enkephalin
3.Leu Enkephalin
4.Angiotensin II

Fig. 5-13 Proteins



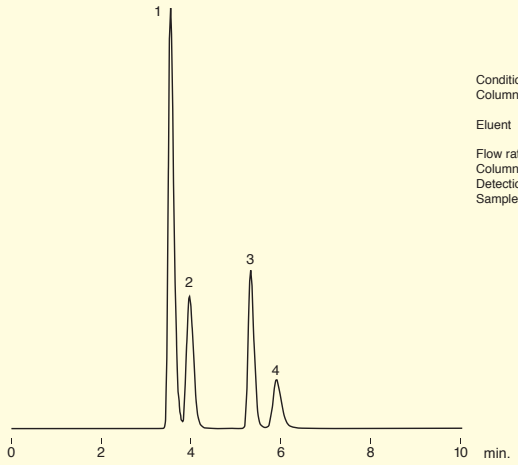
Conditions
Column : MCI GEL® CMG20/C04
4.6mm I.D.×150mm
Eluent : A;0.05%TFA/CH_3CN
=80/20
B;0.05%TFA/CH_3CN
=20/80
A→B 30min.linear
Flow rate : 0.5 mℓ/min
Column temp. : 25°C
Detection : 280nm
Sample : 1.Ribonuclease A
2.Cytochrome c
3.α-Chymotrypsinogen A

Fig. 5-14 Procainamide, Procaine



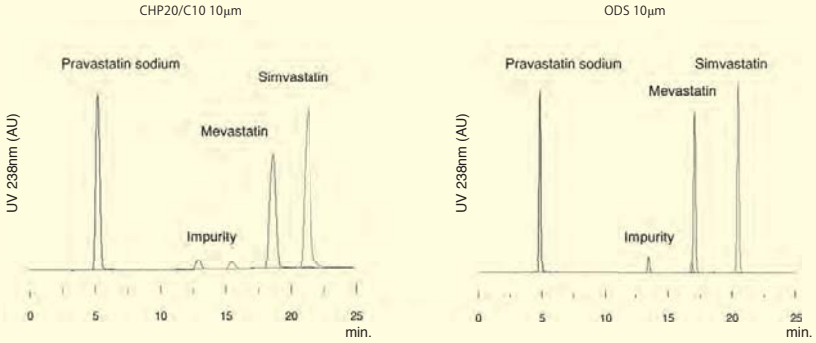
Conditions
Column : MCI GEL® CMG20/C04 4.6mm I.D.×150mm
Eluent : 20mM phosphate pH7.2/CH_3CN =65/35
Flow rate : 0.5 mℓ/min
Column temp. : 45°C
Detection : 254nm
Sample : 1.Procainamide 2.Procaine

Fig. 5-15 Water-soluble vitamins



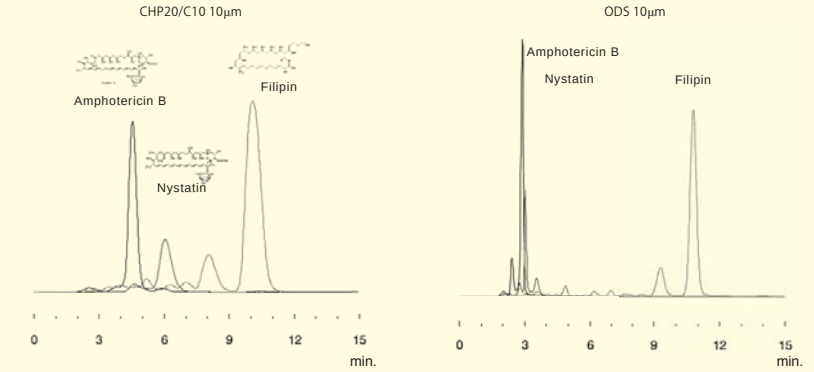
Conditions
Column : MCI GEL® CMG20/C04 4.6mm I.D.×150mm
Eluent : 8mM Na_2HPO_4 pH7.0/CH_3CN =85/15
Flow rate : 0.5 mℓ/min
Column temp. : 25°C
Detection : 254nm
Sample : 1.Vitamin C 2.Vitamin B6 3.Vitamin B3 4.Vitamin B12

Fig. 5-16 Pravastatin sodium



Conditions
Column : MCI GEL® CHP20/C10 (10μm 250 ×4.6mm I.D.) and ODS (10μm 250 ×4.6mm I.D.)
Eluent : A :0.1% Formic acid; B :0.1% Formic acid in AcCN;
Gradient : 45%B-95%B over 29min.
Flow rate : 1.00 mℓ/min
Column temp. : 25℃
Detection : UV238nm
Sample : Pravastatin sodium, Mevastatin and Simvastatin, 1mg/ml each;.
Injection : 5μl

Fig. 5-17 Polyene antibiotics



Conditions
Column : MCI GEL® CHP20/C10 (10μm 250 ×4.6mm I.D.) and ODS (10μm 250 ×4.6mm I.D.)
Eluent : A :0.1% Formic acid; B :0.1% Formic acid in AcCN; A/B=60/40;
Flow rate : 1.00mℓ/min
Column temp. : 25℃
Detection : UV305nm for Nystatin, VIS405nm for Amphotericin B and UV340nm for Filipin;
Sample : Pravastatin sodium, Mevastatin and Simvastatin, 1mg/ml each;.
Injection : 10μl

Application data of CHP series

Fig. 5-18 Proteins

Conditions
Column : MCI GEL® CMG20/C10
4.6mm I.D.×250mm
Eluent : A 0.05% TFA/CH3CN=80/20
B 0.05% TFA/CH3CN=30/70
A → B 45min linear gradient
Flow rate : 0.5 mℓ /min
Column temp. : 25°C
Detection : 280nm
Sample : 1. Ribonuclease A
2. Cytochrome C
3. Transferrin
4. α-Chymotrypshinogen A
5. β-Lactoglobulin

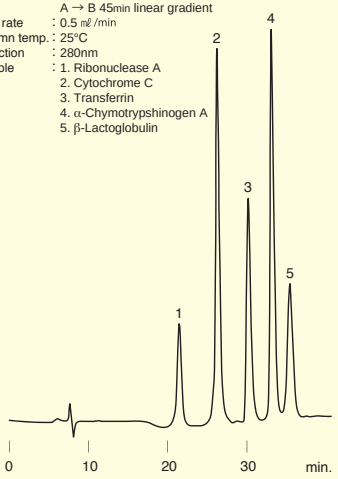


Fig. 5-19 Rice Bran Oil

Conditions
Column : MCI GEL® CMG20/C10(10mm)
4.6mm I.D.×150mm
Eluent : Hexane-EtOH = 98/2 (vol.)
Flow rate : 0.5 mℓ /min
Detection : 295nm
Sample : Rice Bran Oil, 50g/ml
Injection : 10μL

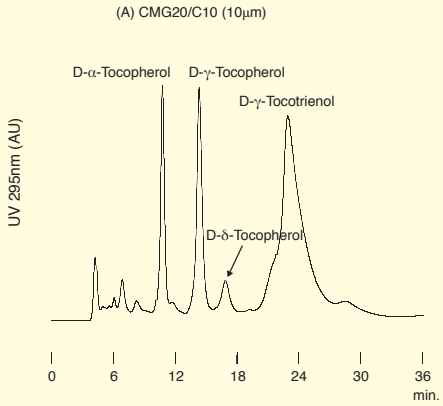
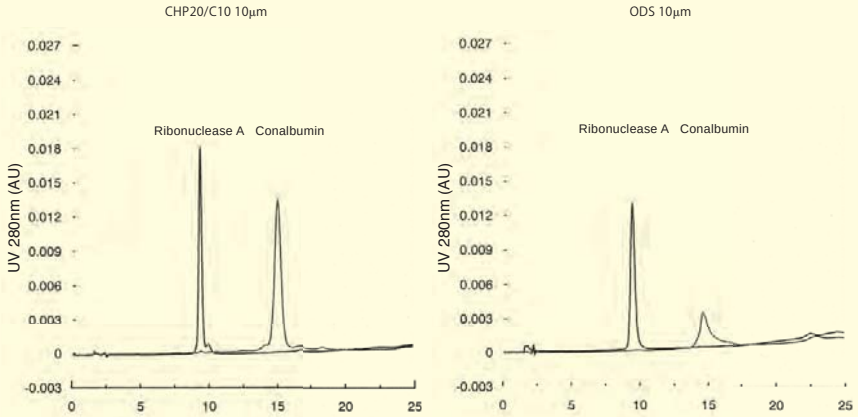


Fig. 5-20 Proteins



Conditions
Column : 150 ×4.6mm I.D.
Eluent : A :0.1% TFA;
B :0.1% TFA in AcCN
Flow rate : 1.00 mℓ /min
Column temp. : 20%B-60%B over 20min;
Detection : UV280nm;
Sample : Ribonuclease A and Conalbumin 2mg/ml;.
Injection : 10μl

Application data of CHP series

(Polyphenon 60)

Fig. 5-21 Modified Styrene Divinylbenzene CHP07/C04

Conditions
Column : MCI GEL® CHP07/C04
4.6mm I.D.×150mm
Eluent : CH3OH/10mM-Acetic acid=60/40
Flow rate : 0.46 mℓ /min
Column temp. : 60°C
Detection : 280nm
Sample : Polyphenon 60(10mg/ mℓ) each 10μL

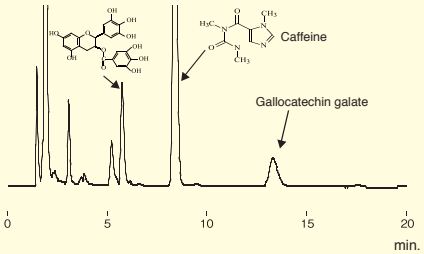
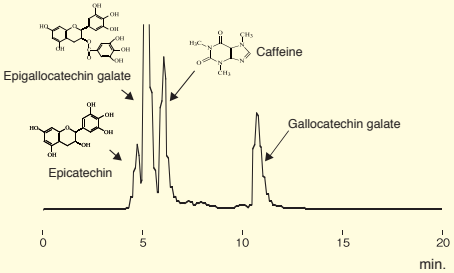


Fig. 5-22 Styrene Divinylbenzene CHP20/C04

Conditions
Column : MCI GEL® CHP20/C04
4.6mm I.D.×150mm
Eluent : CH3OH/10mM-Acetic acid=60/40
Flow rate : 0.46 mℓ /min
Column temp. : 60°C
Detection : 280nm
Sample : Polyphenon 60(10mg/ mℓ) each 10μL



Application data of CHP series

(TritonX-100)

Fig. 5-23 C18-alkylated aliphatics CHPOD/C04

Conditions
Column : MCI GEL® CHPOD/C04
4.6mm I.D.×150mm
Eluent : 50vol%CH3CN
Flow rate : 0.50 mℓ /min
Column temp. : 40°C
Detection : 254nm
Sample : Triton X-100
(Polyoxyethylene octyl phenyl ether)
1% each 10μL

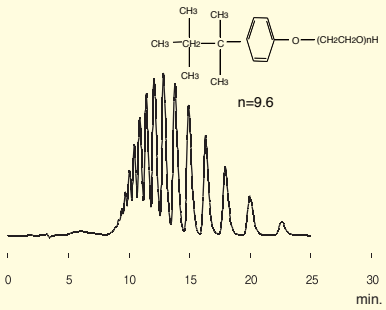
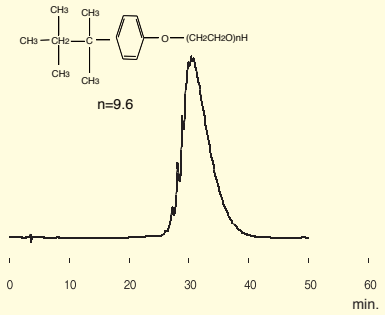


Fig. 5-24 ODS-1HU (ODS)

Conditions
Column : MCI GEL® ODS-1HU
4.6mm I.D.×250mm
Eluent : 50vol%CH3CN
Flow rate : 1.00 mℓ /min
Column temp. : 40°C
Detection : 254nm
Sample : Triton X-100
(Polyoxyethylene octyl phenyl ether)
1% each 10μL



5 MCI GEL®

CHP material series

Polymeric reversed-phase chromatography materials

MCI GEL® CHP material series are chromatography materials of porous type polymers.

Because polymeric materials are chemically stable, wide pH range, from acidic to alkaline eluents are able to be applied to MCI GEL® CHP material series.

MCI GEL® CHP50 series and CHP20 series are both ST/DVB polymers, but they differences in porosity. Pore size of CHP20 series is fairly larger than that of CHP50 series. Appropriate packing material can be selected in accordance with molecular size of injection samples.

●CHP material series

Product name	Old name	Base polymer	Particle size [μm]	Pore diameter [nm]	Main application	Equivalent HPLC column
CHP20/P20	CHP20A	ST/DVB	20	45	Organic compound	CHP20/C04 CHP20/C10
CHP20/P30	CHP20Y		30			
CHP20/P50	CHP20P		50			
CHP20/P70	NEW		70			
CHP20/P120	CHP20P		120			
CHP50/P20	CHP55A	ST/DVB	20	25		–
CHP50/P30	CHP55Y		30			
CSP50/P10	NEW	ST/DVB	10	25		CHP20/C10
CHP07/P120	CSP207P	ST/DVB	120	25		CHP07/C04 CHP07/C10
CMG20/P10	CHP2MG	MA	10	25		CMG20/C04 CMG20/C10
CMG20/P30	CHP2MGY		30			
CMG20/P150	CHP2MGP		150			

ST/DVB；styrene-divinylbenzene　　MA；polymethacrylate

＊CHP5C is abolished and substitute is CSP50/P10.

Application data of CHP series

Fig. 5-25 Phthalic acid esters

Conditions
Column : CHP50/P20, 10mml I.D.×250mmL
Eluent : H_2O/CH_3CN=20/80
Flow rate : 0.75㎖/min
Column temp. : 25°C
Detection : 254nm,
Sample : 1.Dimethyl phthalate 0.5%
2.Dipropyl phthalate 0.5%
3.Dibutyl phthalate 0.5%
100μl

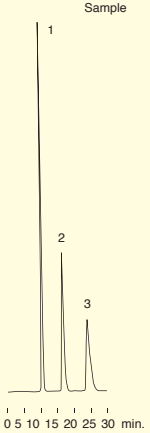
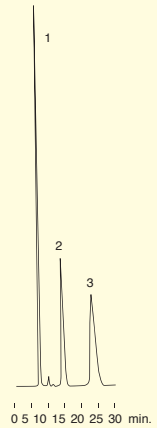


Fig. 5-26 Penicilin antibiotics

Conditions
Column : CHP50/P20, 10mml I.D.×250mmL
Eluent : CH_3OH/0.05M Phosphate buffer (pH8.0)=60/40
Flow rate : 2.18㎖/min
Column temp. : 25°C
Detection : 254nm,
Sample : 1.6-Aminopenicillanic acid 1000ppm
2.Penicillin G 1000ppm
3.Penicillin V 1000ppm
100μl



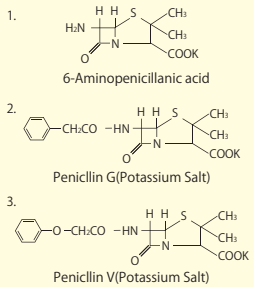


Fig. 5-27 Extract of green tea leaves

Conditions
Column : MCI GEL® CHP50/P20, 32mml.D×465mm
Eluent : 0–185min, CH_3OH:0.01M Acetic acid(35:65)
185–350min, CH_3OH:0.01M Acetic acid(50:50)
Flow rate : 7.48㎖/min
Detection : 280nm
Sample : extract of green tea leaves, injection volumn 18.7㎖
1. Epigallocatechin
2. Catechin
3. Epicatechin
4. Epigallocatechin gallate
5. Gallocatechin
6. Epicatechin gallate
7. Caffeine

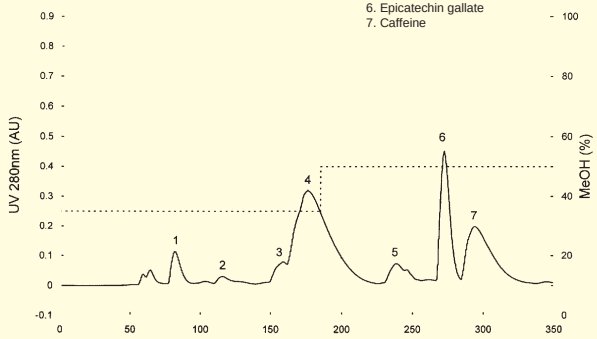


Fig.5-28 Senna pulv. extract

Conditions

	Chromatogram A	Chromatogram B	Chromatogram C
Column	: MCI GEL® CHP20/C10 4.6mm I.D.×250mm	: MCI GEL® CHP20/P20 10.0mm I.D.×250mm	: MCI GEL® CHP20/P30 10.0mm I.D.×250mm
Eluent	: *1	: *1	: *1
Flow rate	: 0.5 mℓ/min	: 2.4 mℓ/min	: 2.4 mℓ/min
Detection	: 270nm	: 270nm	: 270 nm
Sample	: *2 10μL	: *2 80μL	: *2 80 μL

*1: CH_3OH + 1% Acetic acid = 60 + 40 (vol.)
*2: Extract of senna pulv.

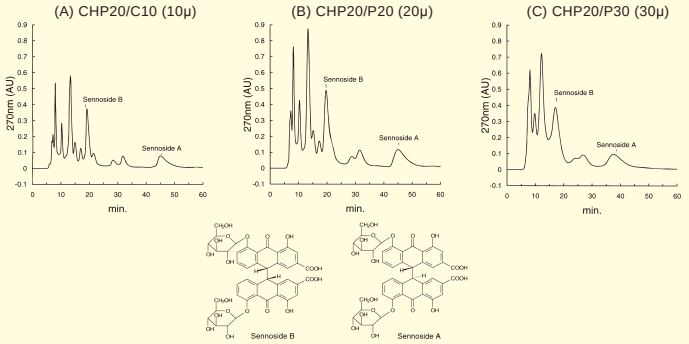


Fig. 5-29 Elution profile of senna pulv. extract separated on MCI GEL® CHP20/P30

Conditions
Column : MCI GEL® CHP20/P30 32mm I.D.×490mm
Eluent : CH_3OH + 1% Acetic acid = 60 + 40 (vol.)
Flow rate : 7.88 mℓ/min
Detection : 270 nm
Sample : Extract of senna pulv., partially purified by Diaion HP20 injected amount : 39.4 mℓ

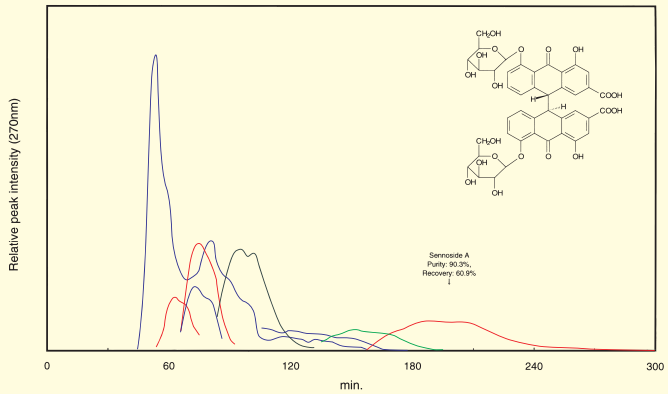


Fig. 5-30 Elution profile of gardenia fructus extract separated on MCI GEL® CHP20/P30

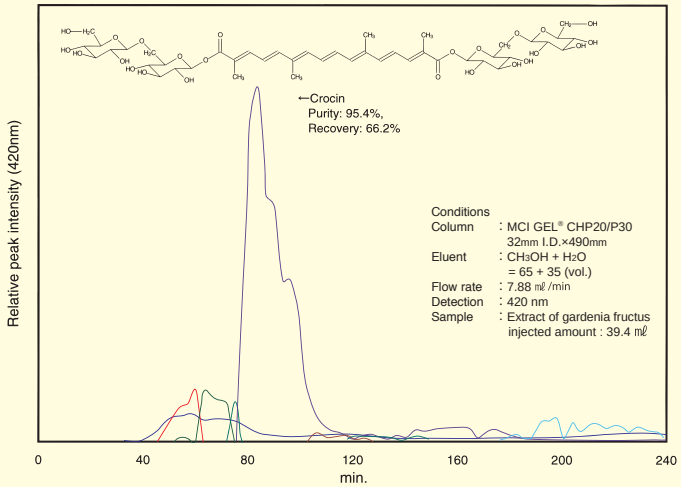
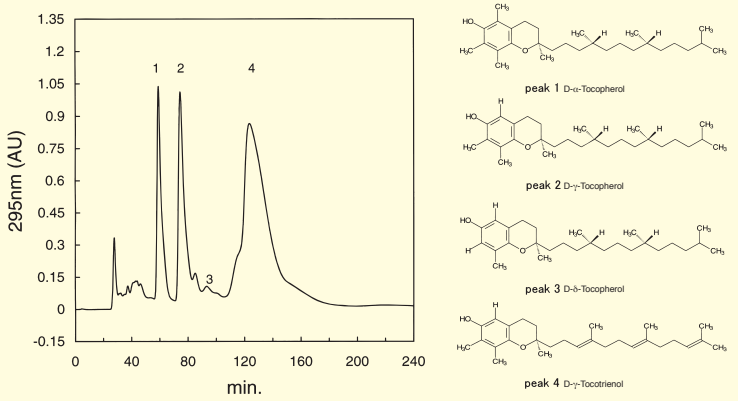


Fig. 5-31 Rice bran oil

Conditions
Column : MCI GEL® CMG20/P30 20mm I.D.×500mm
Eluent : Hexane + C_2H_5OH = 98+2 (vol.)
Flow rate : 4.7 mℓ/min
Detection : 295 nm
Sample : Rice brain oil, 50 mg/mℓ injected amount : 1260μL



6 MCI GEL®
Chiral separation columns

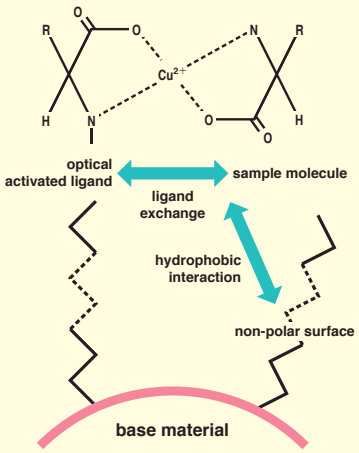
○Chiral separation columns
MCI GEL® CRS10W（DLAA）
MCI GEL® CRS15W（LDAA）


CRS10W 4.6×50

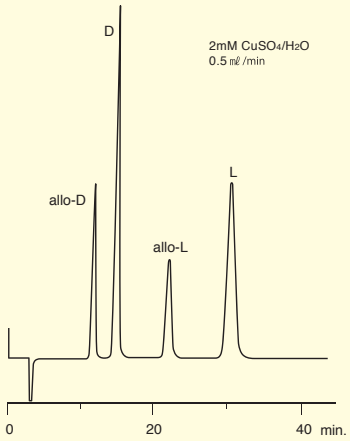

CRS15W 4.6×50

Separation mechanism and performance of MCI GEL® CRS series

Separation mechanism



Application of CRS10W
Fig. 6-1 DL-Isoleucine



●Separation mechanism

MCI GEL® CRS10W and its companion product MCI GEL® CRS15W (an optical isomer of CRS10W) are based on a 3μm with 10nm mean pore diameter of silica gel coated with N,N-Dioctyl -L(or D)-alanine which is a novel optical activated ligand. The chiral resolution mechanism is a combination of ligand exchange and hydrophobic interaction. A copper sulfate aqueous solution is used as an eluent. Elution samples are directly detected at wave length of 254 nm because complex compound, composed of sample molecule and copper in the eluent, are object of detection. With the CRS10W, D-isomers generally elute in front of L-isomers while L-isomers elute ahead of D-isomers on the CRS15W. The hydrophobic interaction mechanism allows hydrophilic samples to elute faster than hydrophobic molecules. Long alkyl chain or aromatic compounds will elute late or require an organic solvent (CH_3CN or CH_3OH, max. of 15v/v%) to prevent adsorption onto the stationary phase.

●Separation performance

1. The CRS series columns separate over 20 D,L-α-Amino acids by only single column. The columns separate not only α-Amino acids but also α-Hydroxy carboxylic acids and derivative amino acids such as Acetylated amino acids.
2. The columns provide excellent resolution operated at room temperature.
3. The columns show high durability.

Application data of CRS10W

For all chromatograms, column temperature is room temperature and wave length is 254nm.
All eluents are $CuSO_4$ aqueous solution except for Fig. 6-9 and Fig. 6-10.

Fig. 6-2 Separation of amino acids mixture

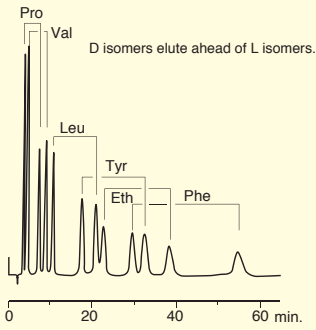


Fig. 6-3 Separation of amino acids mixture

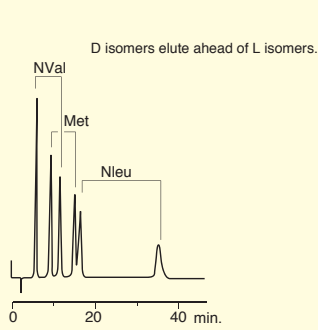


Fig. 6-4 Separation of DL-Ser.

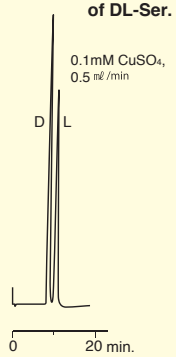


Fig. 6-5 Separation of DL-aspartic acid

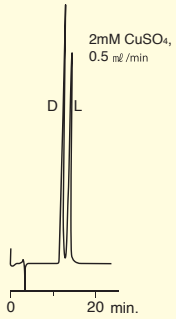


Fig. 6-6 Separation of DL-glutamic acid

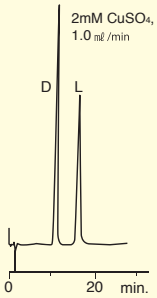


Fig. 6-7 Separation of DL-histidine

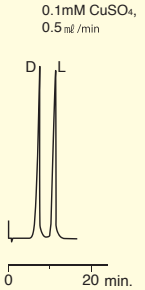


Fig. 6-8 Separation of DL-lysine

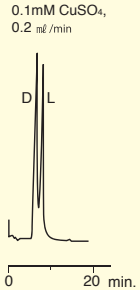


Fig. 6-9 Separation of DL-phenylalanine

Fig. 6-10 Separation of DL-tryptophan

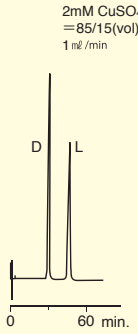


Fig. 6-11 Separation of DL-lactic acid

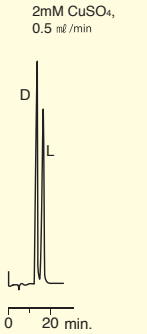
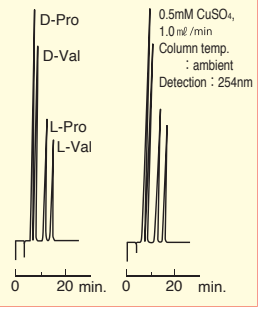


Fig. 6-12 Durability test

The sample was continuously injected 800 times for approximately 500 hrs. Changes of retention times and separation ability are not observed.



Application data of CRS10W

Fig. 6-13 Separation of DL-α-Phenylglycine

Conditions
Column : MCI GEL® CRS10W 4.6mm I.D.×50mm
Eluent : 2mM $CuSO_4$/CH_3OH=85/15
Flow rate : 1.0 mℓ /min
Column temp. : 25°C
Detection : 254nm
Sample : 1. D-α-Phenylglycine
2. L-α-Phenylglycine

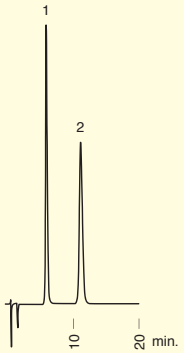


Fig. 6-14 Separation of methionine and acetylmethionine

Conditions
Column : MCI GEL® CRS10W 4.6mm I.D.×50mm
Eluent : 2mM $CuSO_4$/CH_3CN=90/10
Flow rate : 1.0 mℓ /min
Column temp. : 25°C
Detection : 254nm
Sample : 1. D-Met
2. L-Met
3. Acetyl-D-Met
4. Acetyl-L-Met

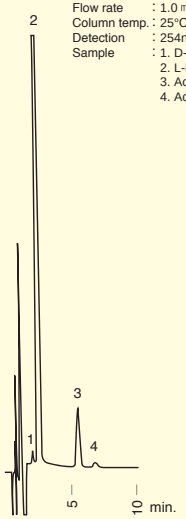
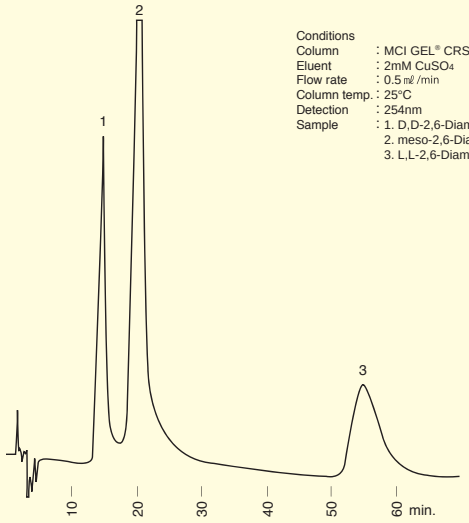


Fig. 6-15 Separation of diaminopimelic acid

Conditions
Column : MCI GEL® CRS10W 4.6mm I.D.×50mm
Eluent : 2mM $CuSO_4$
Flow rate : 0.5 mℓ /min
Column temp. : 25°C
Detection : 254nm
Sample : 1. D,D-2,6-Diaminopimelic acid
2. meso-2,6-Diaminopimelic acid
3. L,L-2,6-Diaminopimelic acid



Application data of CRS10W

Fig. 6-16 Separation of 2-hydroxy carboxylic acids

Conditions
Column : MCI GEL® CRS10W 4.6mm I.D.×50mm
Eluent : 2mM $CuSO_4$/CH_3CN=90/10
Flow rate : 1.0 mℓ /min
Column temp. : ambient
Detection : 254nm
Sample : 1,2=D,L-Lactic acid
3,4=D,L-2-Hydroxy-n-butyric acid
5,6=D,L-α-Hydroxy-n-valeric acid
7,8=D-,L-α-Hydroxy isocaproic acid

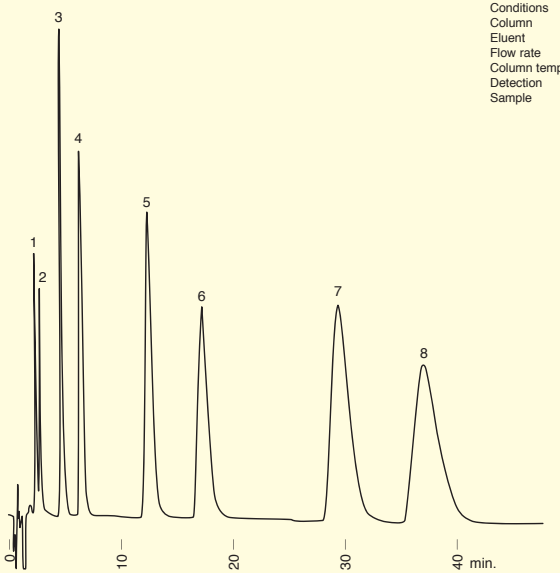
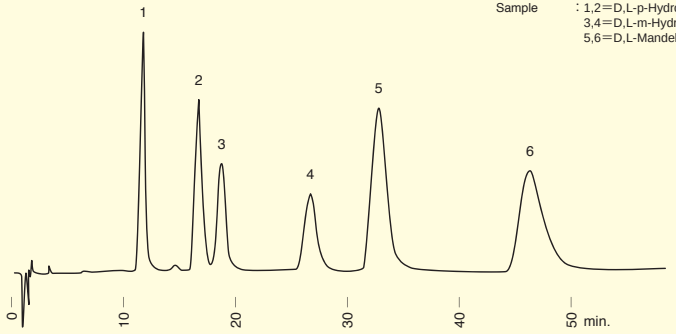


Fig. 6-17 Separation of 2-hydroxy carboxylic acids

Conditions
Column : MCI GEL® CRS10W 4.6mm I.D.×50mm
Eluent : 2mM $CuSO_4$/CH_3CN=90/10
Flow rate : 1.0 mℓ /min
Column temp. : ambient
Detection : 254nm
Sample : 1,2=D,L-p-Hydroxymandelic acid
3,4=D,L-m-Hydroxymandelic acid
5,6=D,L-Mandelic acid



Comparison data of CRS10W and CRS15W

Fig. 6-18 Separation of DL-alanine

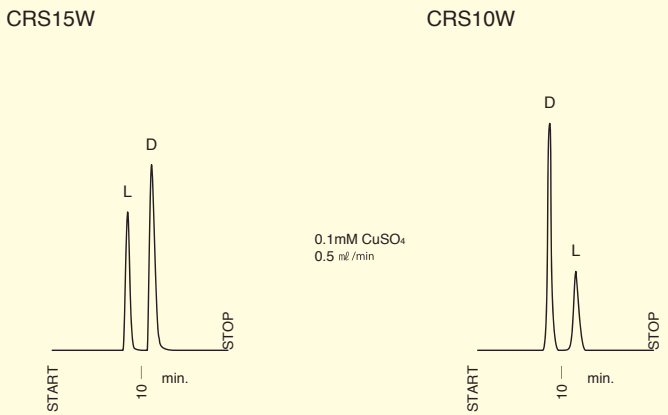
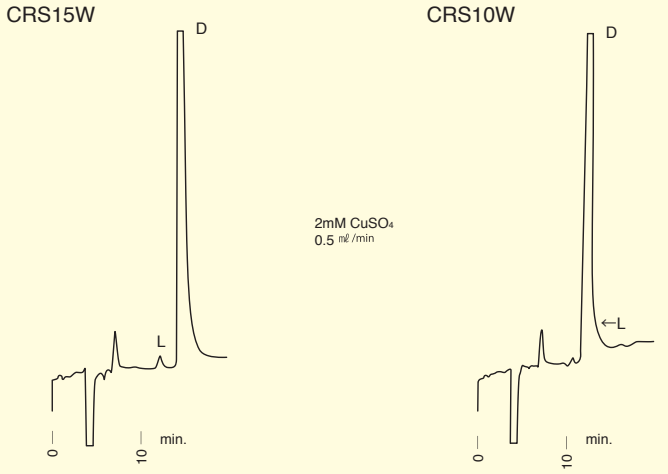


Fig. 6-19 Analysis of a trace of L-lactic acid in 50 ppm D-lactic acid

The CRS15W is recommended for analysis of a trace of L-isomer in a principal D-isomer when the CRS10W does not provide an adequate chromatogram.



Examples of chromatographic conditions and datas

	Amino acids	$CuSO_4$ aq. soln. [mM]	Flow rate [mℓ/min]	Retention time; L-isomers [min]	Separation factor [α]	Separation rate [Rs]
1	Orn•HCl	0.1	0.2	6.8	1.26	<1
2	Lys•HCl	0.1	0.2	7.7	1.45	<1
3	Ala	0.1	0.5	11.0	1.39	1.4
4	His•HCl	0.1	0.5	10.5	1.63	1.7
5	Ser	0.1	0.5	10.1	1.25	1.0
6	Thr	0.1	0.5	11.3	1.29	1.3
7	Cit	0.5	0.5	10.4	1.75	2.3
8	Hyp	1.0	0.2	23.8	1.23	1.1
9	Pro	1.0	1.0	7.3	2.13	4.5
10	Val	1.0	1.0	8.9	2.04	5.0
11	Nval	1.0	1.0	11.5	2.07	4.7
12	Asp	2.0	0.5	13.2	1.18	0.8
13	Glu	2.0	1.0	16.2	1.54	2.3
14	Ileu(DL)	2.0	0.5	30.4	2.14	6.5
15	Ileu(allo)	2.0	0.5	21.9	1.97	6.0
16	Leu	2.0	1.0	14.6	1.97	4.6
17	Nleu	2.0	1.0	24.1	2.16	6.5
18	Met	2.0	1.0	10.3	1.64	2.6
19	Tyr	2.0	1.0	22.5	1.85	5.3
20	Eth	2.0	1.0	26.4	1.69	5.0
21	Phe	2.0	1.0	37.8	1.84	6.3

1. Column temperature; ambient Detection; 254nm
2. These are example data and do not guarantee the column specifications.
3. Improved resolution or appropriate chromatogram can be obtained by further investigating chromatographic conditions.
4. For each amino acid in the table, D-isomer elutes ahead of L-isomer except for Hydroxyproline.

Notes

1. It will take hours for equilibrium between ligand of stationary phase and copper ion of eluent. Two to three hours of conditioning the column with the eluent is advised before sample injection or after changing concentration of $CuSO_4$ of eluent.
2. For acidic amino acids, higher $CuSO_4$ concentration of eluent provides better resolution.
3. For weakly retained hydrophilic amino acids, low flow rate (0.2-0.5 mL/min) yields better resolution.
4. Peak area may decrease with continuous injection of samples, when the concentration of amino acids in sample solution is much higher than that of $CuSO_4$ in the eluent.
5. Please be careful not to flow both water soluble organic solvents (CH_3CN, CH_3OH, etc) and non water soluble organic solvents (n-hexane, chloroform, etc) into the column. The column will be fatally damaged and will never separate optical isomers. Please be particularly careful if HPLC equipment is used together with RP mode and NP mode.
6. Please do not use acid or alkali solutions to adjust pH of eluent. And also do not use buffer solutions. These solutions may cause forming precipitation, hence cause of blockage of the column.
7. For strongly retained hydrophobic amino acids, addition of CH_3CN or CH_3OH in the eluent enables faster elution. The concentration of these organic solvents should be below 15 v/v%.
8. DOPA and other non-polar amino acids will be strongly adsorbed on the packing material and will cause contamination of the column.
9. Regeneration of contaminated column is difficult.

7 MCI GEL®
MCI GEL® column list

Main column			Guard/Pre-column		
Code No.	Name	Column dimensions [mm]	Code No.	Name	Column dimensions [mm]
Ion exchange chromatography cation exchange resin for amino acids					
0-019-01	CK10U	6×120	0-033-21	AFR2-PC	6×50
Ion exchange chromatography cation exchange resin for sugars					
0-009-01	CK08S	8×500	0-009-11	CK08SG	6×50
0-010-01	CK08E	8×300	0-010-11	CK08EG	6×50
0-010-02	CK08EC	8×300	0-010-12	CK08ECG	6×50
0-010-03	CK08ES	8×300	0-010-13	CK08ESG	6×50
Ion exchange chromatography cation exchange resin for carboxylic acids					
0-010-05	CK08EH	8×300	0-010-15	CK08EHG	6×50
Ion exchange chromatography cation exchange resin for oligosaccharides					
0-001-01	CK02A	20×250	0-001-11	CK02AG	8×10
0-001-02	CK02AS	20×250	0-001-12	CK02ASG	8×10
0-003-01	CK04S	10×200	0-017-11 0-003-11	CK10SG CK04SG	6×50 8×10
0-003-02	CK04SS	10×200	0-017-11 0-003-12	CK10SG CK04SSG	6×50 8×10
Ion exchange chromatography anion exchange resin for carboxylic acids and sugars					
0-111-01	CA08F	4.6×250	0-111-11	CA08FG	4×10
0-119-01	CDR10	4.6×250	0-119-11	CDR10G	4×10
Ion chromatography for cations					
0-034-01	SCK01	6×50	0-034-21	SCK-PC	6×50
0-034-04	SCK01	4.6×150			
Ion chromatography for anions					
0-133-01	SCA04/SUS	4.6×150	0-133-12	SCA04G	4.6×30
0-133-02	SCA04/PEEK	4.6×150	0-130-22	SCA-PC	8×10
Bioseparation for size exclusion					
0-213-01	CQP06	7.5×600	0-213-11	CQP06G	4×50
0-214-01	CQP10	7.5×600	0-214-11	CQP10G	4×50
0-215-01	CQP30	7.5×600	0-215-11	CQP30G	4×50
Bioseparation for ion exchange chromatography					
0-146-03	ProtEx-DEAE	4.6×50			
0-146-04	ProtEx-DEAE	7.5×100			
0-037-03	ProtEx-SP	4.6×50			
0-037-04	ProtEx-SP	7.5×100			

Main column			Guard/Pre-column		
Code No.	Name	Column dimensions [mm]	Code No.	Name	Column dimensions [mm]
Bioseparation for ion exchange chromatography					
0-126-01	CQA31S	7.5×75			
0-130-01	CQA35S	7.5×75			
0-036-01	CQK30S	7.5×75			
0-038-01	CQK31S	7.5×75			
Bioseparation for hydrophobic interaction chromatography					
0-216-01	CQH3BS	7.5×75			
0-217-01	CQH3ES	7.5×75			
0-218-01	CQH3PS	7.5×75			
Chiral separation columns					
0-219-01	CRS10W	4.6×50			
0-220-01	CRS15W	4.6×50			

Main column				Guard/Pre-column		
Code No.	Name	Old name	Column dimensions [mm]	Code No.	Name	Column dimensions [mm]
Analytical and preparative chromatography columns for pharmaceutical applications [CHP column series]						
0-401-05	CHP20/C04	CHP10M	4.6X150			
0-401-03	CHP20/C04	CHP10M	20X150			
0-403-01	CHP20/C10	NEW	4.6X250			
0-403-02	CHP20/C10	NEW	10X250			
0-403-03	CHP20/C10	NEW	20X150			
0-403-04	CHP20/C10	NEW	20X250			
0-405-01	CHP07/C04	CHP207M	4.6X150			
0-405-04	CHP07/C04	CHP207M	20X200			
0-406-01	CHP07/C10	CHP207S	4.6X250			
0-406-02	CHP07/C10	CHP207S	10X150			
0-406-03	CHP07/C10	CHP207S	20X150			
0-406-04	CHP07/C10	CHP207S	20X250			
0-402-05	CMG20/C04	CHP2MGM	4.6X150			
0-402-03	CMG20/C04	CHP2MGM	20X150			
0-202-05	CMG20/C10	CHP2MG	4.6X250			
0-202-02	CMG20/C10	CHP2MG	10X250			
0-202-03	CMG20/C10	CHP2MG	20X150			
0-202-04	CMG20/C10	CHP2MG	20X250			
0-504-01	CHPOD/C04	CHPOD1M	4.6X150			
0-504-04	CHPOD/C04	CHPOD1M	20X200			

＊CHP5C is abolished and substitute is CHP20/C10.

8 MCI GEL®
MCI GEL® material list

Characteristics

1. Excellent performance

Sphere packing and sharp particle size distribution provide high performance.

2. Persistence and highest quality

Produced with Mitsubishi Chemical's excellent technology, experience and under strict quality control.

3. Wide range of product line

MCI GEL® packing materials include ion exchange resins (cation and anion), non-functionalized polymer used for reversed phase chromatography and other varieties of products. Also MCI GEL® offers mean particle size of 4 µm to approximately 300 µm packing materials, this means that MCI GEL® products are applied to analysis use and preparative use.

4. Abundant experience

Mitsubishi Chemical has been supplying packing materials for more than 50 years.

●Ion exchange chromatography cation exchange resins [CK series, AFR series]

Code No.	Name	Packing size [g]	Base material	Functional group	Counter ion	Mean particle size [µm]	Cross linkage [%]	Ion exchange capacity [meq/mℓ]	Remarks
1-001-01	CK02A	10	ST/DVB	RSO_3^-	Na^+	20	2	>0.5	Oligosaccharides
1-003-01	CK04S	10	ST/DVB	RSO_3^-	Na^+	11	4	>0.8	Oligosaccharides
1-003-02	CK04S	25							
1-003-03	CK04S	50							
1-004-01	CK06S	10	ST/DVB	RSO_3^-	Na^+	11	6	>1.5	Oligosaccharides
1-004-02	CK06S	25							
1-004-03	CK06S	50							
1-009-01	CK08S	10	ST/DVB	RSO_3^-	Na^+	11	8	>1.9	Sugars, Carboxylic acids
1-009-02	CK08S	25							
1-009-03	CK08S	50							
1-010-01	CK08E	10	ST/DVB	RSO_3^-	Na^+	9	8	>1.9	Sugars, Carboxylic acids
1-010-02	CK08E	25							
1-010-03	CK08E	50							
1-013-01	CK08Y	50	ST/DVB	RSO_3^-	Na^+	25	8	>1.9	Sugars, Carboxylic acids
1-013-02	CK08Y	300							
1-014-01	CK08P	100 mℓ	ST/DVB	RSO_3^-	H^+	120	8	>1.9	Sugars, Carboxylic acids
1-017-01	CK10S	10	ST/DVB	RSO_3^-	Na^+	11	10	>2.0	Carboxylic acids, Amino acids
1-017-02	CK10S	25							
1-017-03	CK10S	50							
1-018-01	CK10F	5	ST/DVB	RSO_3^-	Na^+	7	10	>2.0	Amino acids
1-018-02	CK10F	10							
1-019-01	CK10U	3	ST/DVB	RSO_3^-	Na^+	5	10	>2.0	Amino acids
1-019-03	CK10U	5						>2.0	
1-019-04	CK10U	10							
1-020-05	CK10M	5	ST/DVB	RSO_3^-	Na^+	4	10	>2.0	Amino acids
1-020-06	CK10M	3							
1-021-01	CK10Y	50	ST/DVB	RSO_3^-	Na^+	25	10	>1.9	Amino acids
1-033-01	AFR2	5	ST/DVB	RSO_3^-	H^+	25	–	>1.9	Ammonia trap

Abbreviation; ST/DVB = Styrene-divinylbenzene copolymer

●Ion exchange chromatography anion exchange resins［CA series, CDR series］

Code No.	Name	Packing size [g]	Base material	Functional group	Counter ion	Mean particle size [μm]	Cross linkage [%]	Ion exchange capacity [meq／mℓ]	Remarks
1-104-01	CA06S	10	ST/DVB	QA	Cl^-	11	6	＞1.2	Sugars, Carboxylic acids
1-104-02	CA06S	25							
1-104-03	CA06S	50							
1-109-01	CA08S	10	ST/DVB	QA	Cl^-	11	8	＞1.2	Sugars, Carboxylic acids
1-109-02	CA08S	25							
1-109-03	CA08S	50							
1-111-01	CA08F	5	ST/DVB	QA	Cl^-	7	8	＞1.2	Sugars, Carboxylic acids
1-111-02	CA08F	10							
1-112-01	CA08Y	50	ST/DVB	QA	Cl^-	25	8	＞1.2	Sugars, Carboxylic acids
1-113-01	CA08P	100 mℓ	ST/DVB	QA	Cl^-	120	8	＞1.3	Sugars, Carboxylic acids
1-116-01	CA10S	10	ST/DVB	QA	Cl^-	11	10	＞1.2	Sugars, Carboxylic acids
1-116-02	CA10S	25							
1-116-03	CA10S	50							
1-119-01	CDR10	7	ST/DVB	QA	Cl^-	7	–	＞0.3	Nucleic acids, Sugars
1-119-02	CDR10	14							

Abbreviations； ST/DVB＝styrene-divinyl benzene copolymer　QA；Quaternary ammonium

●Ion chromatography materials［SCA, SCK series］

Code No.	Name	Packing size [g]	Base material	Functional group	Counter ion	Mean particle size [μm]	Cross linkage [%]	Ion exchange capacity [μeq／g]	Remarks
1-034-01	SCK01	5	ST/DVB	RSO_3^-	H^+	11	–	25	Cation analysis
1-034-02	SCK01	10							
1-133-01	SCA04	5	HMA	QA	Cl^-	5	–	30	Anion analysis
1-133-02	SCA04	10							

Abbreviations; ST/DVB ＝ Styrene-divinylbenzene copolymer　HMA ＝ Polyhydroxymethacrylate　QA ＝ Quaternary ammonium

●Bioseparation columns –Size exclusion chromatography materials–［CQP series］

Code No.	Name	Packing size [g]	Base material	Functional group	Counter ion	Mean particle size [μm]	Pore size [nm]	Exclusion limit	Remarks
1-213-01	CQP06	10	HMA	—	—	10	12	1×10^3	Water soluble polymer
1-213-02	CQP06	25							
1-213-03	CQP06	50							
1-214-01	CQP10	10	HMA	—	—	10	20	1×10^4	Water soluble polymer
1-214-02	CQP10	25							
1-214-03	CQP10	50							
1-215-01	CQP30	10	HMA	—	—	10	60	1×10^6	Water soluble polymer
1-215-02	CQP30	25							
1-215-03	CQP30	50							
1-222-01	CQP30P	100 mℓ	HMA	—	—	30	60	1×10^6	

Abbreviation; HMA ＝ Polyhydroxymethacrylate

●Bioseparation columns –Ion exchange materials–［CQA series, CQK series］

Code No.	Name	Packing size [g]	Base material	Functional group	Counter ion	Mean particle size [μm]	Pore size [nm]	pH range	Remarks
1-126-01	CQA31S	10	HMA	DEAE	Cl^-	10	60	＜11	Proteins
1-126-02	CQA31S	25							
1-126-03	CQA31S	50							
1-127-01	CQA31P	100 mℓ	HMA	DEAE	Cl^-	30	60	＜11	
1-130-01	CQA35S	10	HMA	QA	Cl^-	10	60	2～12	Proteins
1-130-02	CQA35S	25							
1-130-03	CQA35S	50							
1-131-01	CQA35P	100 mℓ	HMA	QA	Cl^-	30	60	2～12	
1-036-01	CQK30S	10	HMA	SP	Na^+	10	60	1～13	Proteins
1-036-02	CQK30S	25							
1-036-03	CQK30S	50							
1-037-01	CQK30P	100 mℓ	HMA	SP	Na^+	30	60	1～13	
1-038-01	CQK31S	10	HMA	CM	Na^+	10	60	＞4	Proteins
1-038-02	CQK31S	25							
1-038-03	CQK31S	50							
1-039-01	CQK31P	100 mℓ	HMA	CM	Na^+	30	60	＞4	

Abbreviations; HMA ＝ Polyhydroxymethacrylate　SP ＝ Sulfopropyl　CM ＝ Carboxymethyl　DEAE ＝ Diethylaminoethyl
QA ＝ Quaternary ammonium

●Bioseparation columns –Hydrophobic interaction chromatography materials–

Code No.	Name	Packing size [g]	Base material	Functional group	Counter ion	Mean particle size [μm]	Pore size [nm]	Ion exchange capacity [meq／mℓ]	Remarks
1-216-01	CQH3BS	10	HMA	Butyl	–	10	60	–	Proteins
1-216-02	CQH3BS	25							
1-216-03	CQH3BS	50							
1-217-01	CQH3ES	10	HMA	Ether	–	10	60	–	Proteins
1-217-02	CQH3ES	25							
1-217-03	CQH3ES	50							
1-218-01	CQH3PS	10	HMA	Phenyl	–	10	60	–	Proteins
1-218-02	CQH3PS	25							
1-218-03	CQH3PS	50							
1-226-01	CQH3BP	25	HMA	Butyl	–	30	60	–	Proteins
1-226-02	CQH3BP	100							
1-226-03	CQH3BP	1000 mℓ							
1-227-01	CQH3PP	25	HMA	Phenyl	–	30	60	–	Proteins
1-227-02	CQH3PP	100							
1-227-03	CQH3PP	1000 mℓ							

Abbreviation; HMA ＝ Polyhydroxymethacrylate

●Analytical and preparative chromatography materials for pharmaceutical applications [CHP material series]

Code No.	Product Name	Old Name	Packing size [mℓ]	Base material	Functional group	Counter ion	Mean particle size [μm]	Pore size [nm]	pH range	Remarks
1-307-06	CHP20/P20	CHP20A	25	ST/DVB	–	–	20	45	Whole range	Reversed-phase chromatography
1-307-07	CHP20/P20		100							
1-307-08	CHP20/P20		1,000							
1-305-06	CHP20/P30	CHP20Y	25	ST/DVB	–	–	30	45	Whole range	Reversed-phase chromatography
1-305-07	CHP20/P30		100							
1-305-08	CHP20/P30		1,000							
1-310-01	CHP20/P50	CHP20P	100g	ST/DVB	–	–	50	45	Whole range	Reversed-phase chromatography
1-313-02	CHP20/P70	New	500	ST/DVB	–	–	70	45	Whole range	Reversed-phase chromatography
1-313-03	CHP20/P70		1,000							
1-313-04	CHP20/P70		10,000							
1-311-01	CHP20/P120	CHP20P	100	ST/DVB	–	–	120	45	Whole range	Reversed-phase chromatography
1-311-02	CHP20/P120		500							
1-311-03	CHP20/P120		1,000							
1-311-04	CHP20/P120		10,000							
1-311-05	CHP20/P120		50,000							
1-304-06	CHP50/P20	CHP55A	25	ST/DVB	–	–	20	25	Whole range	Reversed-phase chromatography
1-304-07	CHP50/P20		100							
1-304-08	CHP50/P20		1,000							
1-303-06	CHP50/P30	CHP55Y	25	ST/DVB	–	–	30	25	Whole range	Reversed-phase chromatography
1-303-07	CHP50/P30		100							
1-303-08	CHP50/P30		1,000							
1-312-01	CSP50/P10	New	10g	ST/DVB	–	–	10	25	Whole range	Reversed-phase chromatography
1-312-03	CSP50/P10		1,000							
1-314-02	CHP07/P120	CSP207P	100	ST/DVB	–	–	120	25	Whole range	Reversed-phase chromatography
1-314-03	CHP07/P120		1,000							
1-314-04	CHP07/P120		10,000							
1-314-05	CHP07/P120		50,000							
1-309-01	CMG20/P10	CHP2MG	10g	MA	–	–	10	25	2～12	Reversed-phase chromatography
1-309-03	CMG20/P10		1,000							
1-306-06	CMG20/P30	CHP2MGY	25	MA	–	–	30	25	2～12	Reversed-phase chromatography
1-306-07	CMG20/P30		100							
1-306-08	CMG20/P30		1,000							
1-308-02	CMG20/P150	CHP2MGP	100	MA	–	–	150	25	2～12	Reversed-phase chromatography
1-308-03	CMG20/P150		1,000							
1-308-04	CMG20/P150		10,000							
1-308-05	CMG20/P150		50,000							

Abbreviations; MA＝Polymethacrylate　ST/DVB＝Styrene-divinylbenzene copolymer

＊CHP5C is abolished and substitute is CSP50/P10.

●Synthetic adsorbents for enrichment organic compounds in environmental water

Code No.	Name	Packing size [mℓ]	Base material	Functional group	Counter ion	Mean particle size [μm]	Specific surface area [m²/g]	Ion exchange capacity [meq／mℓ]	Remarks
1-219-01	CSP800	50	ST/DVB	–	–	120	600	–	Synthetic adsorbents for non-ionic substances
1-132-01	CHPA25	20	ST/DVB	QA	Cl^-	220	20	＞2.0	Synthetic adsorbents for anionic substances

Abbreviations; ST/DVB ＝ Styrene-divinylbenzene copolymer　QA ＝ Quaternary ammonium

MCI GEL® CSP800 and MCI GEL® CHPA25 are used for enrichment traces of organic compounds in environmental water with high concentration ratio and high recovery, are recommended for sample preparation for mutagenicity study and GC-MS analysis. The CSP800 is for non-ionic substances such as trichloroethylene. The CHPA25 is for anionic substances such as humin. It is advised combined use these adsorbents.

●Chelating resins for solid phase extraction in pretreatment

Code No.	Name	Packing size	Functional group	Mean particle size [μm]	Cross linkage [%]	Ion exchange capacity [meq／mℓ]	Remarks
1-601-02	CHL10P	100g	Iminodiacetic acid	120	–	＞1.5	Metal
1-602-02	CHL20P	100g	Polyamine	120	–	＞1.8	Metal
1-603-02	CLB10P	100g	Glucamine	120	–	＞1.0	Bron

We have an assortment of MCI GEL® CHL series as solid phase adsorbents for the pretreatment in analyzing rare earth metals.
We can also provide solid phase adsorbents with various micro-pore sizes and hydrophobicity, i.e. chemical structures, for R&D of new pharmaceuticals.

●Reversed-phase materials

Code No.	Name	Old name	Packing size	Functional group	Mean particle size [μm]	Pore size [nm]	Protein exclusion limit [MW]	pH range	Remarks
1-505-02	CHPOD/P30	CHPOD1Y	100 g	–	30	25	–	2～12	Reversed-phase chromatography
1-315-02	CHP85/P120	CHP50P	100 mℓ	–	120	–	＜14,000	Whole range	Reversed-phase chromatography
1-316-02	CHP87/P120	CHP75P	100 mℓ	–	120	–	≪14,000	Whole range	Reversed-phase chromatography

CHP85/P120 and CHP87/P120 with the controlled micro-pore size, in particular, have a distinctive advantage not to adsorb high molecular weight proteins but to adsorb only low molecular weight organic compounds.

9 MCI GEL®
Compounds index

	Compound	Classification	MCI GEL® column	Figure	Page
1	Acetic acid	Carboxylic acid	CK08EH	2-12	11
2	Acetic acid	Carboxylic acid	CK08EH	2-17	12
3	Acetic acid	Carboxylic acid	CK08EH	2-18	12
4	Acetic acid	Carboxylic acid	CA08F	2-32	17
5	Acetic acid	Carboxylic acid	CA08F	2-33	18
6	Acetic acid	Carboxylic acid	CA08F	2-34	18
7	N-Acetylgalactosamine	Amino sugar	CK08EH	2-13	11
8	N-Acetylglucosamine	Amino sugar	CK08EH	2-13	11
9	Acetyl-D-Met.	Acetyl-D-amino acid	CRS10W	6-14	59
10	Acetyl-L-Met.	Acetyl-L-amino acid	CRS10W	6-14	59
11	Adenine	Nucleic base	CDR10	2-35	19
12	Adenosine	Nuleoside	SCK01	3-6	22
13	Adonitol	Sugar alcohol	CK08EC	2-4	9
14	5'-ADP	Nucleotide	CDR10	2-35	19
15	Alanine	Amino acid	CK10U	2-1	7
16	β-Alanine	Amino acid	CK10U	2-2	8
17	D-Alanine	D-Amino acid	CRS10W/CRS15W	6-18	61
18	L-Alanine	L-Amino acid	CRS10W/CRS15W	6-18	61
19	γ-Aminobutyric acid	Amino acid	CK10U	2-3	8
20	6-Aminopenicillanic acid	Penicillin antibiotic	CHP50/P20	5-26	54
21	Ammonia	Ammonia	SCK01	3-2	22
22	Ammonium ion	Cation	SCK01	3-1	22
23	Ammonium ion	Cation	SCK01	3-3	22
24	2'-AMP	Nucleotide	CDR10	2-35	19
25	2'-AMP	Nucleotide	CDR10	2-36	19
26	3'-AMP	Nucleotide	CDR10	2-36	19
27	5'-AMP	Nucleotide	CDR10	2-35	19
28	5'-AMP	Nucleotide	CDR10	2-36	19
29	Amphotericin B	Antibiotic	CHP20/C10	5-17	50
30	Angiotensin II	Peptide	CMG20/C04	5-12	48
31	Antipyrine	Ingredients of medicine	CMG20/C04	5-10	47
32	Arginine	Amino acid	CK10U	2-1	7
33	Aspartic acid	Amino acid	CK10U	2-1	7
34	D-Aspartic acid	D-Amino acid	CRS10W	6-5	58
35	L-Aspartic acid	L-Amino acid	CRS10W	6-5	58
36	Aspirin	Ingredients of medicine	CMG20/C04	5-10	47
37	5'-ATP	Nucleotide	CDR10	2-35	19
38	Bacitracin	Peptide	CQH3PS	4-26	38
39	Barium ion	Cation	SCK01	3-7	23
40	Bovine Serum Albumin	Protein	ProtEx-DEAE	4-9	32
41	Bromide ion	Anion	SCA04	3-12	24
42	Bromide ion	Anion	SCA04	3-13	24
43	n-Butyl alcohol	Alcohol	CK08EH	2-14	11
44	sec-Butyl alcohol	Alcohol	CK08EH	2-14	11
45	Cadmium ion	Cation	SCK01	3-8	23
46	Caffeine	Purine alkaloid	CHP20/C04	5-4	44
47	Caffeine	Ingredients of medicine	CMG20/C04	5-10	47
48	Caffeine	Purine alkaloid	CHP50/P20	5-27	54
49	Calcium ion	Cation	SCK01	3-7	23
50	Calcium ion	Cation	SCK01	3-8	23
51	Calcium ion	Cation	SCK01	3-9	23
52	Calcium ion	Cation	SCK01	3-10	23
53	Calcium ion	Cation	SCK01	3-11	23
54	Carbonate ion	Anion	SCA04	3-15	25
55	Catechin	Catechin	CHP50/P20	5-27	54
56	Cellobiose	Disaccharide	CA08F	2-31	17
57	Cellobiose	Disaccharide	CDR10	2-37	20
58	Cesium ion	Cation	SCK01	3-1	22
59	Chloride ion	Anion	SCA04	3-12	24
60	Chloride ion	Anion	SCA04	3-13	24
61	Chloride ion	Anion	SCA04	3-14	25
62	Chloride ion	Anion	SCA04	3-15	25
63	Chloride ion	Anion	SCA04	3-17	26
64	Chloroacetic acid	Carboxylic acid	CK08EH	2-17	12
65	Chloroacetic acid	Carboxylic acid	CK08EH	2-18	12
66	Cholic acid	Bile acid	CHP20/C04	5-7	45
67	α-Chymotrypsinogen A	Protein	ProtEx-SP	4-10	32
68	α-Chymotrypsinogen A	Protein	CQK31S	4-21	36
69	α-Chymotrypsinogen A	Protein	CQK30S	4-21	36
70	α-Chymotrypsinogen A	Protein	CQH3BP	4-27	39
71	α-Chymotrypsinogen A	Protein	CQH3BS	4-27	39
72	α-Chymotrypsinogen A	Protein	CQH3PP	4-28	39
73	α-Chymotrypsinogen A	Protein	CQH3PS	4-28	39
74	α-Chymotrypsinogen A	Protein	CMG20/C04	5-13	48
75	α-Chymotrypsinogen A	Protein	CMG20/C10	5-18	51
76	Cinchonine	Cinchona alkaloid	CHP20/C04	5-5	44
77	Citric acid	Carboxylic acid	CK08EH	2-12	11
78	Citric acid	Carboxylic acid	CA08F	2-32	17
79	Citric acid	Carboxylic acid	CA08F	2-33	18
80	2'-CMP	Nucleotide	CDR10	2-36	19
81	3'-CMP	Nucleotide	CDR10	2-36	19
82	5'-CMP	Nucleotide	CDR10	2-35	19
83	5'-CMP	Nucleotide	CDR10	2-36	19
84	Cobalt ion	Cation	SCK01	3-8	23
85	Colibacillus extract	Protein	CQH3ES	4-24	38
86	Colibacillus extract	Protein	CQH3PS	4-25	38
87	Collagenase	Protein	ProtEx-DEAE	4-15	34
88	Conalbumin	Protein	ProtEx-DEAE	4-5	31
89	Conalbumin	Protein	CHP20/C10	5-20	51
90	Corticosterone	Adrenal cortex hormone	CHP20/C04	5-9	46
91	Crocin	Crude drug	CHP20/P30	5-30	56
92	3',5'-Cyclic AMP	Nucleotide	CDR10	2-35	19
93	Cystine	Amino acid	CK10U	2-1	7
94	Cytidine	Nucleoside	SCK01	3-6	22
95	Cytochrome C	Protein	CQP30	4-3	29
96	Cytochrome C	Protein	ProtEx-SP	4-10	32
97	Cytochrome C	Protein	CQK30S	4-20	36
98	Cytochrome C	Protein	CQK31S	4-20	36
99	Cytochrome C	Protein	CMG20/C04	5-13	48
100	Cytochrome C	Protein	CMG20/C10	5-18	51
101	Cytosine	Nucleic base	CDR10	2-35	19
102	Deoxycholic acid	Bile acid	CHP20/C04	5-7	45
103	11-Deoxycortisol	Adrenal cortex hormone	CHP20/C04	5-9	46
104	Deoxyribose	Deoxysugar	CA08F	2-31	17
105	Deoxyribose	Deoxysugar	CDR10	2-37	20
106	D,D-2,6-Diaminopimelic acid	D,D-Diamino carboxylic acid	CRS10W	6-15	59
107	L,L-2,6-Diaminopimelic acid	L,L-Diamino carboxylic acid	CRS10W	6-15	59
108	meso-2,6-Diaminopimelic acid	meso-Diamino carboxylic acid	CRS10W	6-15	59
109	Dibutyl phthalate	Phthalic acid ester	CHP50/P20	5-25	54
110	Dichloroacetic acid	Carboxylic acid	CK08EH	2-17	12
111	Dichloroacetic acid	Carboxylic acid	CK08EH	2-18	12
112	Diethylene glycol	Polyalcohol	CK08EH	2-16	12
113	Diethyl phthalate	Phthalic acid ester	CHP20/C04	5-3	43
114	Dimethylamine	Amine	SCK01	3-2	22
115	4-Dimethylaminoantipyrine	Ingredients of medicine	CMG20/C04	5-10	47
116	Dimethyl phthalate	Phthalic acid ester	CHP20/C04	5-3	43
117	Dimethyl phthalate	Phthalic acid ester	CHP50/P20	5-25	54
118	Dipropyl phthalate	Phthalic acid ester	CHP20/C04	5-3	43
119	Dipropyl phthalate	Phthalic acid ester	CHP50/P20	5-25	54
120	Dopamine	Catecholamine	CHP20/C04	5-2	43
121	Epicatechin	Catechin	CHP50/P20	5-27	54
122	Epicatechin gallate	Catechin	CHP50/P20	5-27	54
123	Epigallocatechin	Catechin	CHP50/P20	5-27	54
124	Epigallocatechin gallate	Catechin	CHP50/P20	5-27	54
125	Epinephrine	Catecholamine	CHP20/C04	5-2	43

	Compound	Classification	MCI GEL® column	Figure	Page
126	Erythritol	Sugar alcohol	CK08EC	2-11	10
127	meso-Erythritol	Sugar alcohol	CK08EC	2-4	9
128	D-Ethionine	D-Amino acid	CRS10W	6-2	58
129	L-Ethionine	L-Amino acid	CRS10W	6-2	58
130	Ethyl alcohol	Alcohol	CK08EC	2-11	10
131	Ethyl alcohol	Alcohol	CK08EH	2-14	11
132	Ethyl alcohol	Alcohol	CK08EH	2-15	11
133	Ethylene glycol	Polyalcohol	CK08EH	2-15	11
134	Ethylene glycol	Polyalcohol	CK08EH	2-16	12
135	Extract of green tea leaves	Catechins	CHP50/P20	5-27	54
136	Ferritin	Protein	CQP30	4-3	29
137	Filipin	Antibiotic	CHP20/C10	5-17	50
138	Fluroride ion	Anion	SCA04	3-12	24
139	Fluroride ion	Anion	SCA04	3-13	24
140	Formic acid	Carboxylic acid	CK08EH	2-12	11
141	Formic acid	Carboxylic acid	CA08F	2-32	17
142	Fructose	Sugar	CK08EC	2-4	9
143	Fructose	Sugar	CK08EC	2-5	9
144	Fructose	Sugar	CK08EC	2-7	10
145	Fructose	Sugar	CK08EC	2-8	10
146	Fructose	Sugar	CK08EC	2-9	10
147	Fructose	Sugar	CK08EC	2-10	10
148	Fructose	Sugar	CK08EC	2-11	10
149	Fructose	Sugar	CK04S	2-28	16
150	Fructose	Sugar	CK04S	2-29	16
151	Fructose	Sugar	CK04S	2-30	16
152	Fructose	Sugar	CA08F	2-31	17
153	Fructose	Sugar	CDR10	2-37	20
154	Fructo-oligosaccharide	Fructo-oligosaccharide	CK04S	2-30	16
155	Fucose	Sugar	CA08F	2-31	17
156	Galactose	Sugar	CK08EC	2-6	9
157	Galactose	Sugar	CA08F	2-31	17
158	Galactose	Sugar	CDR10	2-37	20
159	Gallocatechin	Catechin	CHP50/P20	5-27	54
160	Gentiobiose	Disaccharide	CK08EC	2-4	9
161	Gluconic acid	Carboxylic acid	CA08F	2-33	18
162	Gluconic acid	Carboxylic acid	CA08F	2-34	18
163	Gluconic acid	Carboxylic acid	CQP06	4-4	29
164	Glucose	Sugar	CK08EC	2-4	9
165	Glucose	Sugar	CK08EC	2-5	9
166	Glucose	Sugar	CK08EC	2-7	10
167	Glucose	Sugar	CK08EC	2-8	10
168	Glucose	Sugar	CK08EC	2-9	10
169	Glucose	Sugar	CK08EC	2-10	10
170	Glucose	Sugar	CK08EC	2-11	10
171	Glucose	Sugar	CK08EH	2-13	11
172	Glucose	Sugar	CK04S	2-28	16
173	Glucose	Sugar	CK04S	2-29	16
174	Glucose	Sugar	CK04S	2-30	16
175	Glucose	Sugar	CA08F	2-31	17
176	Glucose	Sugar	CDR10	2-37	20
177	Glucose	Sugar	CQP06	4-4	29
178	Glutamic acid	Amino acid	CK10U	2-1	7
179	D-Glutamic acid	D-Amino acid	CRS10W	6-6	58
180	L-Glutamic acid	L-Amino acid	CRS10W	6-6	58
181	Glycerol	Polyalcohol	CK08EC	2-11	10
182	Glycerol	Polyalcohol	CK08EH	2-15	11
183	Glycine	Amino acid	CK10U	2-1	7
184	Glycohemoglobin	Protein	ProtEx-SP	4-11	32
185	Glycolic acid	Carboxylic acid	CK08EH	2-12	11
186	Glycolic acid	Carboxylic acid	CK08EH	2-18	12
187	Glycyrrhizic acid	Chinese medicinal drug	CHP20/C04	5-8	46
188	Gly-Tyr	Peptide	CMG20/C04	5-12	48
189	3'-GMP	Nucleotide	CDR10	2-36	19
190	5'-GMP	Nucleotide	CDR10	2-36	19

	Compound	Classification	MCI GEL® column	Figure	Page
191	5'-GTP	Nucleotide	CDR10	2-35	19
192	Guanosine	Nucleoside	SCK01	3-6	22
193	Hemoglobin A0	Protein	ProtEx-DEAE	4-6	31
194	Hemoglobin A2	Protein	ProtEx-DEAE	4-6	31
195	Hemoglobin S	Protein	ProtEx-DEAE	4-6	31
196	Histidine	Amino acid	CK10U	2-1	7
197	D-Histidine	D-Amino acid	CRS10W	6-7	58
198	L-Histidine	L-Amino acid	CRS10W	6-7	58
199	Human growth hormone	Hormone	ProtEx-DEAE	4-7	31
200	Human serum	Serum	CQH3ES	4-23	38
201	Human serum	Serum	CQH3PS	4-23	38
202	Hydrocortisone	Adrenal cortex hormone	CHP20/C04	5-9	46
203	5-Hydroxytryptophan	Amino acid	CHP20/C04	5-2	43
204	D-2-Hydroxy-n-butyric acid	D-α-Hydroxycarboxylic acid	CRS10W	6-16	60
205	L-2-Hydroxy-n-butyric acid	L-α-Hydroxycarboxylic acid	CRS10W	6-16	60
206	D-α-Hydroxy isocaproic acid	D-α-Hydroxycarboxylic acid	CRS10W	6-16	60
207	L-α-Hydroxy isocaproic acid	L-α-Hydroxycarboxylic acid	CRS10W	6-16	60
208	D-α-Hydroxy-n-valeric acid	D-α-Hydroxycarboxylic acid	CRS10W	6-16	60
209	L-α-Hydroxy-n-valeric acid	L-α-Hydroxycarboxylic acid	CRS10W	6-16	60
210	D-m-Hydroxymandelic acid	D-α-Hydroxycarboxylic acid	CRS10W	6-17	60
211	L-m-Hydroxymandelic acid	L-α-Hydroxycarboxylic acid	CRS10W	6-17	60
212	D-p-Hydroxymandelic acid	D-α-Hydroxycarboxylic acid	CRS10W	6-17	60
213	L-p-Hydroxymandelic acid	L-α-Hydroxycarboxylic acid	CRS10W	6-17	60
214	Hypoxanthine	Uric acid related compound	CHP20/C04	5-6	45
215	IgG1 MOPC21(mouse)	monoclonal antibody	ProtEx-DEAE	4-16	34
216	IgG2b, κ (mouse)	monoclonal antibody	ProtEx-DEAE	4-14	33
217	5'-IMP	Nucleotide	CDR10	2-36	19
218	Interleukin 2	Protein	ProtEx-DEAE	4-9	32
219	Isoleucine	Amino acid	CK10U	2-1	7
220	D-Isoleucine	D-Amino acid	CRS10W	6-1	57
221	L-Isoleucine	L-Amino acid	CRS10W	6-1	57
222	allo-D-Isoleucine	D-Amino acid	CRS10W	6-1	57
223	allo-L-Isoleucine	L-Amino acid	CRS10W	6-1	57
224	Isopropyl alcohol	Alcohol	CK08EH	2-14	11
225	Isopropyl alcohol	Alcohol	CK08EH	2-15	11
226	Lactic acid	Carboxylic acid	CK08EH	2-12	11
227	Lactic acid	Carboxylic acid	CA08F	2-32	17
228	Lactic acid	Carboxylic acid	CA08F	2-34	18
229	D-Lactic acid	D-α-Hydroxycarboxylic acid	CRS10W	6-11	58
230	L-Lactic acid	L-α-Hydroxycarboxylic acid	CRS10W	6-11	58
231	D-Lactic acid	D-α-Hydroxycarboxylic acid	CRS10W	6-16	60
232	L-Lactic acid	L-α-Hydroxycarboxylic acid	CRS10W	6-16	60
233	D-Lactic acid	D-α-Hydroxycarboxylic acid	CRS10W/CRS15W	6-19	61
234	L-Lactic acid	L-α-Hydroxycarboxylic acid	CRS10W/CRS15W	6-19	61
235	β-Lactoglobulin	Protein	CQA31S	4-19	35
236	β-Lactoglobulin	Protein	CQA35S	4-19	35
237	β-Lactoglobulin	Protein	CMG20/C10	5-18	51
238	Lactose	Disaccharide	CK08EC	2-4	9
239	Lactose	Disaccharide	CK08EC	2-6	9
240	Lactose	Disaccharide	CA08F	2-31	17
241	Lactose	Disaccharide	CDR10	2-37	20
242	Lactulose	Disaccharide	CK08EC	2-6	9
243	Leucine	Amino acid	CK10U	2-1	7
244	D-Leucine	D-Amino acid	CRS10W	6-2	58
245	L-Leucine	L-Amino acid	CRS10W	6-2	58
246	Leu Enkephalin	Peptide	CQH3PS	4-26	38
247	Leu Enkephalin	Peptide	CMG20/C04	5-12	48
248	Lipoxidase	Enzyme	CQA31S	4-22	36
249	Lithium ion	Cation	SCK01	3-1	22
250	Lysine	Amino acid	CK10U	2-1	7
251	D-Lysine	D-Amino acid	CRS10W	6-8	58
252	L-Lysine	L-Amino acid	CRS10W	6-8	58
253	Lysozyme	Protein	CQK30S	4-20	36
254	Lysozyme	Protein	CQK31S	4-20	36
255	Magnesium ion	Cation	SCK01	3-7	23

	Compound	Classification	MCI GEL® column	Figure	Page
256	Magnesium ion	Cation	SCK01	3-9	23
257	Magnesium ion	Cation	SCK01	3-10	23
258	Magnesium ion	Cation	SCK01	3-11	23
259	Malic acid	Carboxylic acid	CK08EH	2-12	11
260	Malic acid	Carboxylic acid	CA08F	2-32	17
261	Malonic acid	Carboxylic acid	CK08EH	2-12	11
262	Malonic acid	Carboxylic acid	CA08F	2-32	17
263	Maltose	Disaccharide	CA08F	2-31	17
264	Maltose	Disaccharide	CDR10	2-37	20
265	D-Mandelic acid	D-α-Hydroxycarboxylic acid	CRS10W	6-17	60
266	L-Mandelic acid	L-α-Hydroxycarboxylic acid	CRS10W	6-17	60
267	Manganese ion	Cation	SCK01	3-8	23
268	Mannitol	Sugar alcohol	CK08EC	2-4	9
269	Mannitol	Sugar alcohol	CK08EC	2-11	10
270	Mannose	Sugar	CK08EC	2-4	9
271	Mannose	Sugar	CA08F	2-31	17
272	Mannose	Sugar	CDR10	2-37	20
273	Melibiose	Disaccharide	CA08F	2-31	17
274	Melibiose	Disaccharide	CDR10	2-37	20
275	Met Enkephalin	Peptide	CMG20/C04	5-12	48
276	Methionine	Amino acid	CK10U	2-1	7
277	D-Methionine	D-Amino acid	CRS10W	6-3	58
278	L-Methionine	L-Amino acid	CRS10W	6-3	58
279	D-Methionine	D-Amino acid	CRS10W	6-14	59
280	L-Methionine	L-Amino acid	CRS10W	6-14	59
281	Methyl alcohol	Alcohol	CK08EH	2-15	11
282	Methylamine	Amine	SCK01	3-2	22
283	Met-Leu-Tyr	Peptide	CQH3PS	4-26	38
284	Mevastatin	Medicine	CHP20/C10	5-16	50
285	Mouse brain sap	Mouse brain sap	ProtEx-DEAE	4-12	33
286	Myoglobin	Protein	CQP30	4-3	29
287	Myoglobin	Protein	ProtEx-DEAE	4-5	31
288	Myoglobin	Protein	CQA31S	4-18	35
289	Myoglobin	Protein	CQA35S	4-18	35
290	Myoglobin	Protein	CQA31S	4-19	35
291	Myoglobin	Protein	CQA35S	4-19	35
292	Myoglobin	Protein	CQK30S	4-20	36
293	Myoglobin	Protein	CQK31S	4-20	36
294	Nitrate ion	Anion	SCA04	3-12	24
295	Nitrate ion	Anion	SCA04	3-13	24
296	Nitrate ion	Anion	SCA04	3-14	25
297	Nitrate ion	Anion	SCA04	3-15	25
298	Nitrate ion	Anion	SCA04	3-17	26
299	Nitrite ion	Anion	SCA04	3-12	24
300	Nitrite ion	Anion	SCA04	3-13	24
301	D-Norleucine	D-Amino acid	CRS10W	6-3	58
302	L-Norleucine	L-Amino acid	CRS10W	6-3	58
303	D-Norvaline	D-Amino acid	CRS10W	6-3	58
304	L-Norvaline	L-Amino acid	CRS10W	6-3	58
305	Nystatin	Antibiotic	CHP20/C10	5-17	50
306	Oligosaccharide	Dp1-Dp9	CK04S	2-21	15
307	Oligosaccharide	Dp1-Dp13	CK04S	2-22	15
308	Oligosaccharide	Dp1-Dp15	CK02A	2-23	15
309	Oligosaccharide	Dp1-Dp20	CK02AS	2-24	15
310	Oligosaccharide	Dp1-Dp7	SCK04S	2-25	16
311	Oligosaccharide	Dp1-Dp7	CK04SS	2-26	16
312	Oligosaccharide	Dp1-Dp7	CK02AS	2-27	16
313	Orotic acid	Uric acid related compound	CHP20/C04	5-6	45
314	Ovalbumin	Protein	CQP30	4-3	29
315	Ovalbumin	Protein	CQA31S	4-18	35
316	Ovalbumin	Protein	CQA35S	4-18	35
317	Oxalic acid	Carboxylic acid	CK08EH	2-12	11
318	Pancreatin	Digestive enzyme	ProtEx-DEAE	4-17	34
319	Penicillin G	Penicillin antibiotic	CHP50/P20	5-26	54
320	Penicillin V	Penicillin antibiotic	CHP50/P20	5-26	54

	Compound	Classification	MCI GEL® column	Figure	Page
321	Phenacetin	Ingredients of medicine	CMG20/C04	5-10	47
322	Phenylalanine	Amino acid	CK10U	2-1	7
323	D-Phenylalanine	D-Amino acid	CRS10W	6-2	58
324	L-Phenylalanine	L-Amino acid	CRS10W	6-2	58
325	D-Phenylalanine	D-Amino acid	CRS10W	6-9	58
326	L-Phenylalanine	L-Amino acid	CRS10W	6-9	58
327	D-α-Phenylglycine	D-Amino acid	CRS10W	6-13	59
328	L-α-Phenylglycine	L-Amino acid	CRS10W	6-13	59
329	Phosphate	Anion	SCA04	3-12	24
330	Polyethyleneglycol	Water soluble polymer	CQP30	4-2	29
331	Polyphenon 60	Polyphenol	CHP07/C04	5-21	52
332	Polyphenon 60	Polyphenol	CHP20/C04	5-21	52
333	Potassium ion	Cation	SCK01	3-1	22
334	Potassium ion	Cation	SCK01	3-3	22
335	Potassium ion	Cation	SCK01	3-4	22
336	Potassium ion	Cation	SCK01	3-5	22
337	Prabastatin Na	Medicine	CHP20/C10	5-16	50
338	Procainamide	Procainamide	CMG20/C04	5-14	49
339	Procaine	Procaine	CMG20/C04	5-14	49
340	Proline	Amino acid	CK10U	2-1	7
341	D-Proline	D-Amino acid	CRS10W	6-2	58
342	L-Proline	L-Amino acid	CRS10W	6-2	58
343	n-Propyl alcohol	Alcohol	CK08EH	2-14	11
344	Propylene glycol	Polyalcohol	CK08EH	2-15	11
345	Quinine	Cinchona alkaloid	CHP20/C04	5-5	44
346	Rhamnose	Sugar	CA08F	2-31	17
347	Rhamnose	Sugar	CDR10	2-37	20
348	Ribonuclease A	Protein	ProtEx-SP	4-10	32
349	Ribonuclease A	Protein	CQK30S	4-20	36
350	Ribonuclease A	Protein	CQK31S	4-20	36
351	Ribonuclease A	Protein	CQK31S	4-21	36
352	Ribonuclease A	Protein	CQK30S	4-21	36
353	Ribonuclease A	Protein	CQH3BP	4-27	39
354	Ribonuclease A	Protein	CQH3PP	4-27	39
355	Ribonuclease A	Protein	CMG20/C04	5-13	48
356	Ribonuclease A	Protein	CMG20/C10	5-18	51
357	Ribonuclease A	Protein	CHP20/C10	5-20	51
358	Ribose	Sugar	CK08EC	2-4	9
359	Ribose	Sugar	CA08F	2-31	17
360	Ribose	Sugar	CDR10	2-37	20
361	RNA	RNA	ProtEx-DEAE	4-13	33
362	Rubidium ion	Cation	SCK01	3-1	22
363	Salicin	Phenol glycoside	CK08EC	2-4	9
364	Sennoside A	Crude drug	CHP20/C10	5-28	55
365	Sennoside A	Crude drug	CHP20/P20	5-28	55
366	Sennoside A	Crude drug	CHP20/P30	5-28	55
367	Sennoside A	Crude drug	CHP20/P30	5-29	55
368	Sennoside B	Crude drug	CHP20/C10	5-28	55
369	Sennoside B	Crude drug	CHP20/P20	5-28	55
370	Sennoside B	Crude drug	CHP20/P30	5-28	55
371	Serine	Amino acid	CK10U	2-1	7
372	D-Serine	D-Amino acid	CRS10W	6-4	58
373	L-Serine	L-Amino acid	CRS10W	6-4	58
374	Serotonin	Catecholamine	CHP20/C04	5-2	43
375	Simvastatin	Medicine	CHP20/C10	5-16	50
376	Sodium ion	Cation	SCK01	3-1	22
377	Sodium ion	Cation	SCK01	3-3	22
378	Sodium ion	Cation	SCK01	3-4	22
379	Sodium ion	Cation	SCK01	3-5	22
380	Sorbitol	Sugar alcohol	CK08EC	2-5	9
381	Sorbitol	Sugar alcohol	CK08EH	2-15	11
382	Stachyose	Tetrasaccharide	CK08EC	2-4	9
383	Strontium ion	Cation	SCK01	3-7	23
384	Strontium ion	Cation	SCK01	3-8	23
385	Succinylsulfathiazole	Sulfa drugs	CMG20/C04	5-11	47

	Compound	Classification	MCI GEL® column	Figure	Page
386	Sucrose	Disaccharide	CK08EC	2-5	9
387	Sucrose	Disaccharide	CK08EC	2-7	10
388	Sucrose	Disaccharide	CK08EC	2-8	10
389	Sucrose	Disaccharide	CK04S	2-30	16
390	Sulfate ion	Anion	SCA04	3-12	24
391	Sulfate ion	Anion	SCA04	3-13	24
392	Sulfate ion	Anion	SCA04	3-14	25
393	Sulfate ion	Anion	SCA04	3-15	25
394	Sulfate ion	Anion	SCA04	3-16	26
395	Sulfamerazine	Sulfa drugs	CMG20/C04	5-11	47
396	Sulfanilamide	Sulfa drugs	CMG20/C04	5-11	47
397	Sufathiazole	Sulfa drugs	CMG20/C04	5-11	47
398	Tartaric acid	Carboxylic acid	CK08EH	2-12	11
399	Tartaric acid	Carboxylic acid	CA08F	2-32	17
400	Theobromine	Purine alkaloid	CHP20/C04	5-4	44
401	Theophylline	Purine alkaloid	CHP20/C04	5-4	44
402	Theophylline	Purine alkaloid	CHP20/C04	5-6	45
403	Thiocyanic ion	Anion	SCA04	3-16	26
404	Thiosulfuric ion	Anion	SCA04	3-16	26
405	Threonine	Amino acid	CK10U	2-1	7
406	Thymine	Nucleic base	CDR10	2-35	19
407	D-α-tocopherol	Vitamin	CMG20/C10	5-19	51
408	D-γ-tocopherol	Vitamin	CMG20/C10	5-19	51
409	D-δ-tocopherol	Vitamin	CMG20/C10	5-19	51
410	D-γ-tocotrienol	Vitamin	CMG20/C10	5-19	51
411	D-α-tocopherol	Vitamin	CMG20/P30	5-31	56
412	D-δ-tocopherol	Vitamin	CMG20/P30	5-31	56
413	D-γ-tocopherol	Vitamin	CMG20/P30	5-31	56
414	D-γ-tocotrienol	Vitamin	CMG20/P30	5-31	56
415	TPN	Nucleotide	CDR10	2-35	19
416	Transferrin	Protein	CQA31S	4-19	35
417	Transferrin	Protein	CQA35S	4-19	35
418	Transferrin	Protein	CQH3BP	4-27	39
419	Transferrin	Protein	CQH3BS	4-27	39
420	Transferrin	Protein	CQH3PP	4-28	39
421	Transferrin	Protein	CQH3PS	4-28	39
422	Transferrin	Protein	CMG20/C10	5-18	51
423	Trichloroacetic acid	Carboxylic acid	CK08EH	2-17	12
424	Triethyleneglycol	Polyalcohol	CK08EH	2-16	12
425	Trimethylamine	Amine	SCK01	3-2	22
426	TritonX-100	Surfactant	CHPOD/04	5-23	52
427	TritonX-100	Surfactant	ODS-1HU	5-24	52
428	Trypsin Inhibitor	Enzyme	ProtEx-DEAE	4-5	31
429	Trypsin Inhibitor	Enzyme	CQA31S	4-18	35
430	Trypsin Inhibitor	Enzyme	CQA35S	4-18	35
431	Trypsinogen	Enzyme	CQK30S	4-21	36
432	Trypsinogen	Enzyme	CQK31S	4-21	36
433	Tryptophan	Amino acid	CHP20/C04	5-2	43
434	D-Tryptophan	D-Amino acid	CRS10W	6-10	58
435	L-Tryptophan	L-Amino acid	CRS10W	6-10	58
436	Tyrosine	Amino acid	CK10U	2-1	7
437	D-Tyrosine	D-Amino acid	CRS10W	6-2	58
438	L-Tyrosine	L-Amino acid	CRS10W	6-2	58
439	3'-UMP	Nucleotide	CDR10	2-36	19
440	5'-UMP	Nucleotide	CDR10	2-36	19
441	Uracil	Nucleic base	CDR10	2-35	19
442	Uric acid	Uric acid	CHP20/C04	5-6	45
443	Uridine	Nucleoside	SCK01	3-6	22
444	Urine	Urine	CDR10	2-38	20
445	Ursodeoxycholic acid	Bile acid	CHP20/C04	5-7	45
446	Valine	Amino acid	CK10U	2-1	7

	Compound	Classification	MCI GEL® column	Figure	Page
447	Valine	Amino acid	CK10U	2-2	8
448	D-Valine	D-Amino acid	CRS10W	6-2	58
449	L-Valine	L-Amino acid	CRS10W	6-2	58
450	Vitamin B3	Water soluble vitamin	CMG20/C04	5-15	49
451	Vitamin B6	Water soluble vitamin	CMG20/C04	5-15	49
452	Vitamin B12	Water soluble vitamin	CMG20/C04	5-15	49
453	Vitamin C	Water soluble vitamin	CMG20/C04	5-15	49
454	Xanthine	Uric acid related compound	CHP20/C04	5-6	45
455	Xylitol	Sugar alcohol	CK08EC	2-4	9
456	Xylitol	Sugar alcohol	CK08EH	2-15	11
457	Xylose	Sugar	CA08F	2-31	17
458	Xylose	Sugar	CDR10	2-37	20
459	Zinc ion	Cation	SCK01	3-8	23

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