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

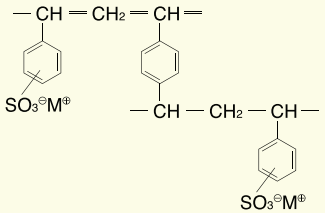
2. Persistence of high quality, excellent separation performance

3. Accumulation of abundant knowledge and experience of applications

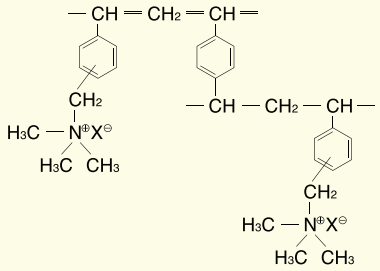
Ion exchange resins are generally used for analysis of amino acids, sugars, organic acids and amines, etc. MCI GEL™ custom pre-packed columns are specifically designed for each application using the most appropriate packing material among our product line and using the most suitable column dimensions.
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]	USP	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	L58		○				
	MCI GEL™ CK08E	8.0□300 7.8□300	8	Na^+	9	L58		○				
	MCI GEL™ CK08EC	8.0□300 7.8□300	8	Ca^{2+}	9	L19		○				
	MCI GEL™ CK08ES	8□300	8	Ag^+	9			○	○			
	MCI GEL™ CK08EH	8.0□300 7.8□300	8	H^+	9	L17		○		○	○	
	MCI GEL™ CK06SC	8□500	6	Ca^+	11			○	○			
	MCI GEL™ CK04S	10□200	4	Na^+	11	L58			○			
	MCI GEL™ CK04SS	10□200	4	Ag^+	11				○			
	MCI GEL™ CK02A	20□250	2	Na^+	20	L58			○			
	MCI GEL™ CK02AS	20□250	2	Ag^+	20				○			
MCI GEL™ Anion exchange columns	MCI GEL™ CA08F	4.6□250	8	SO_4^{2-}	7			○		○		
	MCI GEL™ CDR10	4.6□250	High porous	AcO^-	7			○		○		○

●Packing materials

Packing materials are available. Please look at P.64 and P.65.

●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)

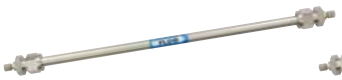
●Note ; Pre-column and guard column

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.

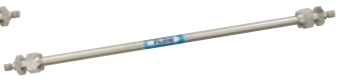
2 MCI GEL™

CK08,06 series

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



CK08EC 8×300, 7.8×300



CK08EH 8×300, 7.8×300

●Column list

MCI GEL™ column	Counter ion	Application areas	USP
MCI GEL™ CK08S MCI GEL™ CK08E	Na^+	General sugar separation columns	L58
MCI GEL™ CK08EC	Ca^{2+}	The most general sugar separation column Highly recommended for fructose and glucose This column conforms to US Pharmacopeia.	L19
MCI GEL™ CK08ES	Ag^+	Gel permeation chromatographic effect	
MCI GEL™ CK08EH	H^+	Organic acids with H_3PO_4 eluent; sugars with distilled water eluent	L17
MCI GEL™ CK06SC	Ca^{2+}	Use for analysis of mono-saccharides and disaccharides.	

Application data of CK08EC

Fig. 2-1 Sugars

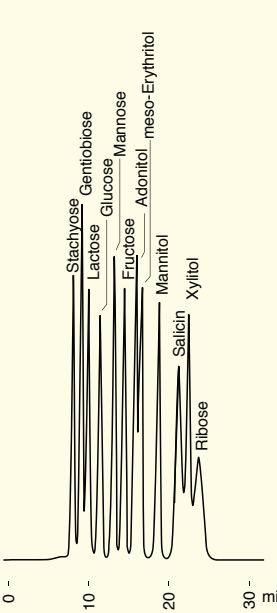


Fig. 2-2 Apple juice

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

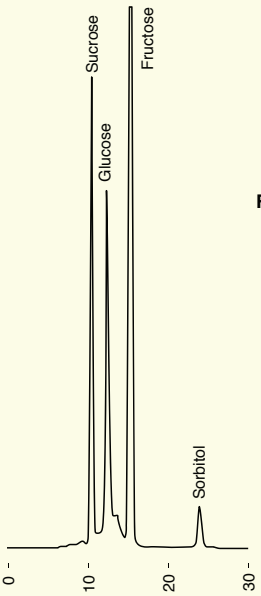
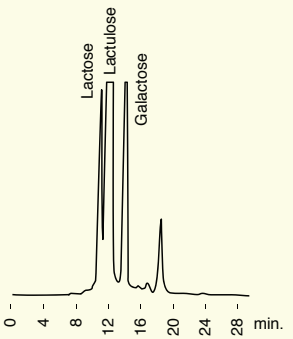


Fig. 2-3 Lactulose syrup



Application data of CK08EC

Fig. 2-4 Sports drink A

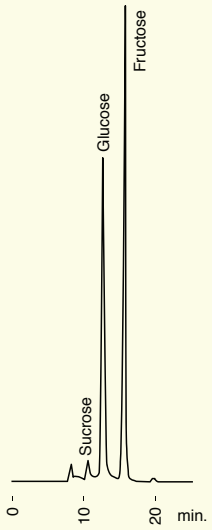


Fig. 2-5 Sports drink B

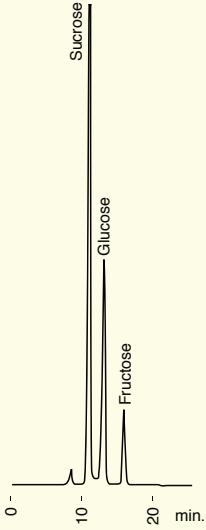


Fig. 2-6 Honey

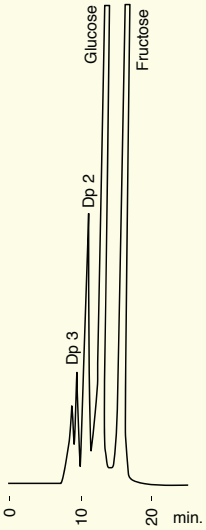


Fig. 2-7 Jam

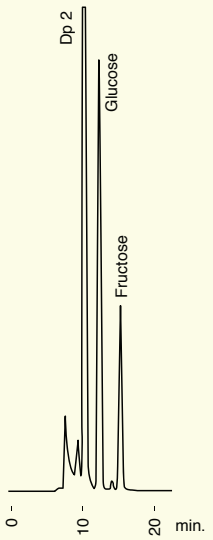
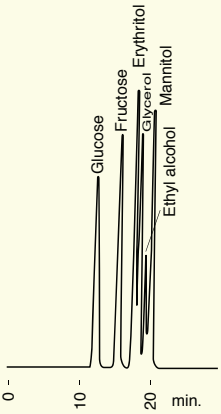


Fig. 2-8 Sugars/Alcohols



Conditions

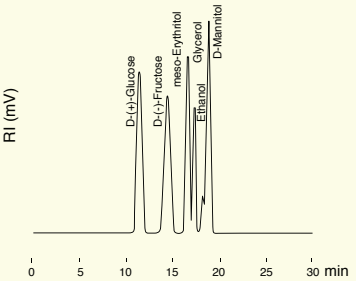
Column	: MCI GEL™ CK08EC 8mm I.D.×300mm
Eluent	: H_2O
Flow rate	: 0.6 mℓ/min
Column temp.	: 75°C
Detection	: RI

Application data of CK08EC

Fig. 2-9 Sugars／Alcoles（Comparison with competitor's column）

Conditions
Column : 7.8x 300 mmI.D. (MCI GEL™ CK08EC / Competitor's Column)
Eluent : Milli Q water
Flow rate : 0.6 mℓ/min
Temperature : 75 °C
Sample Conc : 40mmol/ml each
Injection : 20μL

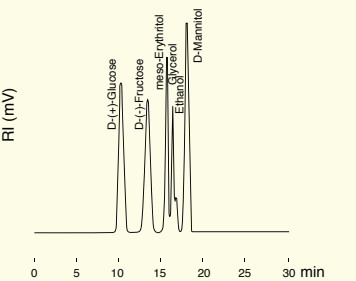
① MCI GEL™ CK08EC (7.8□300mm)



Results:		Rt	TPN	As	Rs
	D-(+)-Glucose	11.39	2085	1.07	-
	D-(-)-Fructose	14.39	2597	0.97	2.89
	meso-Erythritol	16.59	16899	0.84	2.66
	Glycerol	17.31	19051	0.95	1.40
	Ethanol	18.18	37357	0.80	2.12
	D-Mannitol	18.83	12885	1.00	1.33

Pressure: 28Bar (Including system pressure)

② Competitor's Column



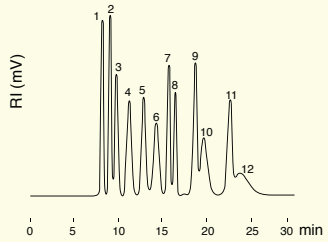
Results:		Rt	TPN	As	Rs
	D-(+)-Glucose	10.25	1509	1.12	-
	D-(-)-Fructose	13.37	2210	0.98	2.93
	meso-Erythritol	15.63	15833	0.90	2.78
	Glycerol	16.32	21608	0.95	1.50
	Ethanol	16.73	35525	1.69	1.14
	D-Mannitol	17.99	10387	0.96	2.43

Pressure: 38Bar (Including system pressure)

Fig. 2-10 Sugars（Comparison with competitor's column）

Conditions
Column : 7.8x 300 mmI.D. (MCI GEL™ CK08EC / Competitor's Column)
Eluent : Milli Q water
Flow rate : 0.6 mℓ/min
Temperature : 75 °C
Sample Conc : 40mmol/ml each
Injection : 20μL

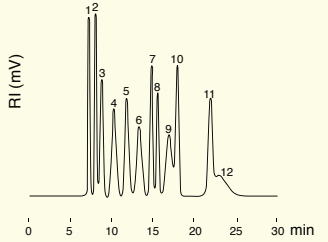
① MCI GEL™ CK08EC (7.8□300mm)



Results:		Rt	TPN	As	Rs
1	Stachyose hydrate	8.25	5111	1.04	-
2	β-Gentiobiose	9.13	5504	0.97	1.86
3	α-Lactose monohydrate	9.83	3024	1.19	1.22
4	D-(+)-Glucose	11.27	2002	1.09	1.77
5	D-(+)-Mannose	12.90	3350	1.01	1.76
6	D-(-)-Fructose	14.32	2713	1.01	1.47
7	Ribitol (Adonitol)	15.78	15410	0.84	1.85
8	meso-Erythritol	16.50	17734	0.99	1.43
9	D-Mannitol	18.73	13044	0.87	3.90
10	D-(-)-Salicin	19.69	4104	1.35	1.08
11	Xylitol	22.66	13965	0.88	3.09
12	D-(-)-Ribose	23.75	2278	2.09	0.86

Pressure: 28Bar (Including system pressure)

② Competitor's Column

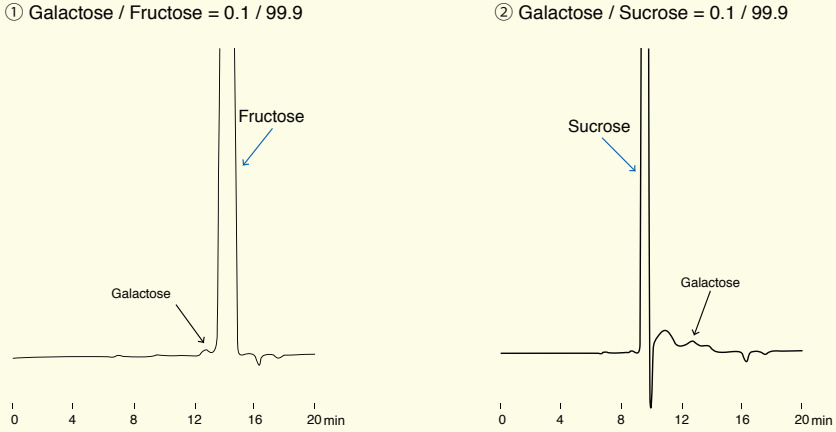


Results:		Rt	TPN	As	Rs
1	Stachyose hydrate	7.21	4243	1.07	-
2	β-Gentiobiose	8.02	4397	1.01	1.78
3	α-Lactose monohydrate	8.76	2249	1.14	1.28
4	D-(+)-Glucose	10.23	1441	1.06	1.73
5	D-(+)-Mannose	11.78	2830	1.03	1.63
6	D-(-)-Fructose	13.27	2188	1.00	1.51
7	Ribitol (Adonitol)	14.76	13744	0.92	1.86
8	meso-Erythritol	15.51	16005	1.01	1.50
9	D-(-)-Salicin	16.86	3594	0.88	1.79
10	D-Mannitol	17.88	12043	1.07	1.23
11	Xylitol	21.90	13235	0.94	5.72
12	D-(-)-Ribose	22.87	2381	3.00	0.86

Pressure: 39Bar (Including system pressure)

Application data of CK08EC

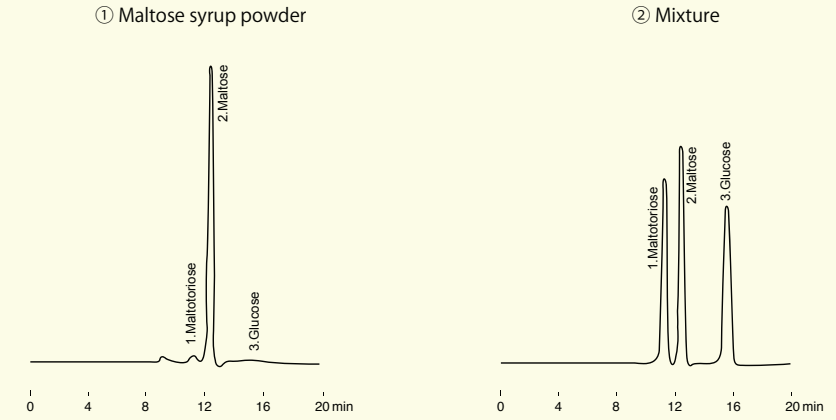
Fig. 2-11 Analysis of galoctose impurity



Conditions
Column : MCI GEL™ CK08EC 7.8mm I.D.×300mm
Eluent : Milli Q water
Flow rate : 0.6 mℓ/min
Temp : 85°C

Application data of CK08E

Fig. 2-12 Maltose syrup powder



Conditions
Column : MCI GEL™ CK08E 7.8mm I.D.×300mm
Eluent : Milli Q water
Flow rate : 0.4 mℓ/min
Temp : 50°C
Sample : 1.Maltotoriose
2.Maltose
3.Glucose
Injection : 5µl.

Application data of CK08EH

Fig. 2-13 Carboxylic acids

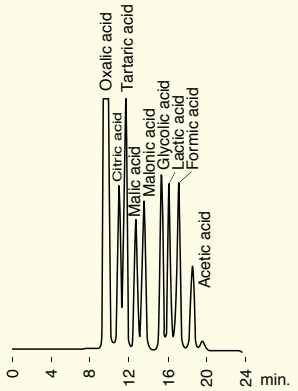
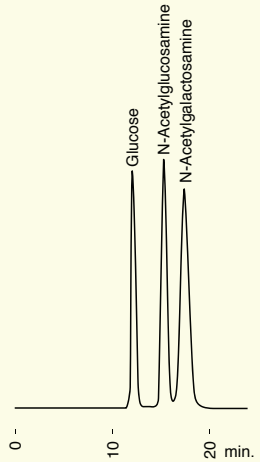
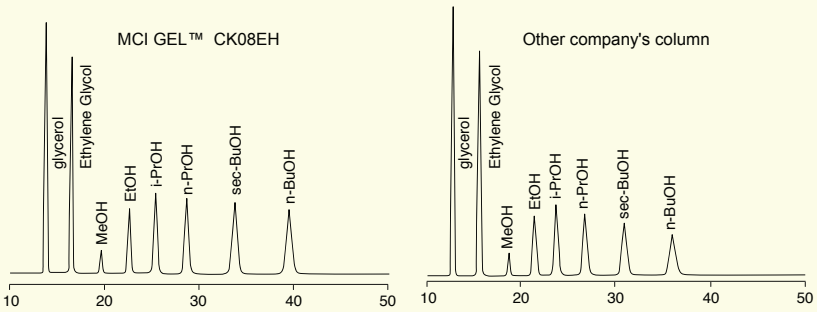


Fig. 2-14 Amino sugars



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

Fig. 2-15 Alcohols



Conditions
Column : MCI GEL™ CK08EH, 7.8mm I.D.×300mm
Temp : 60 °C
Press : 2.5 bar
Detection : RI
Injection : 10.0 µL

Application data of CK08EH

Fig. 2-16 Chloroacetic acids

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

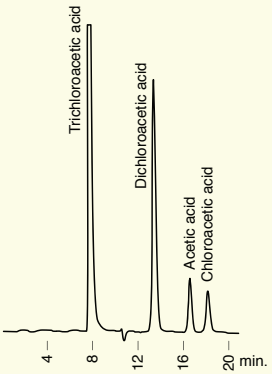


Fig. 2-17 Poly alcohols

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

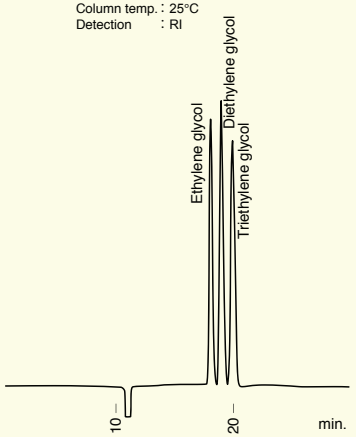
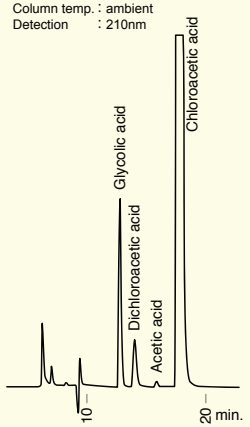


Fig. 2-18 Carboxylic acids

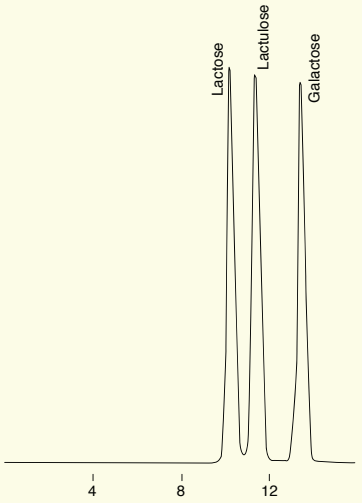
Conditions
Column : MCI GEL™ CK08EH
8mm I.D.×300mm
Eluent : 2% H_3PO_4
Flow rate : 0.6 mℓ/min
Column temp. : ambient
Detection : 210nm



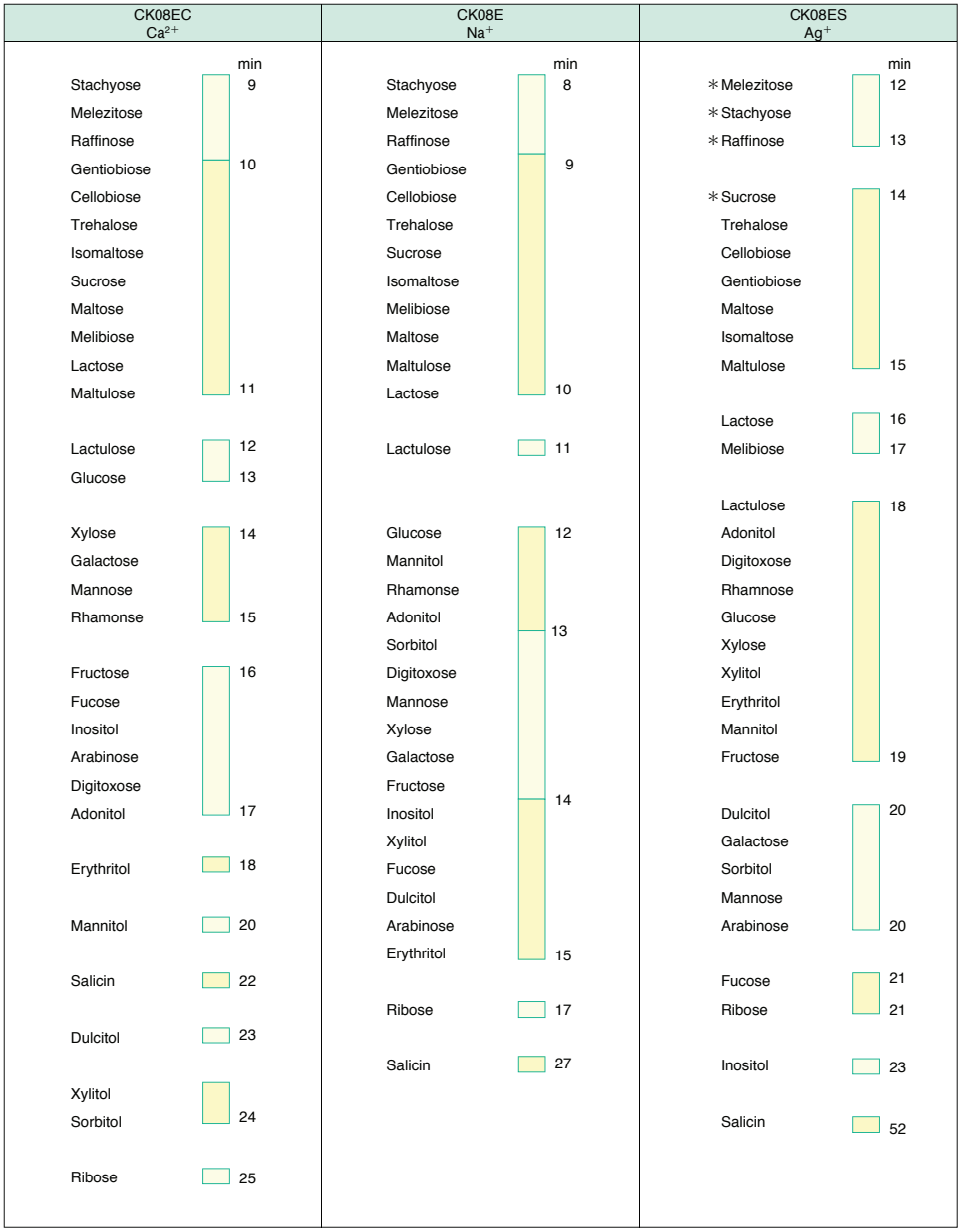
Application data of CK06SC

Fig. 2-19 Lactose

Conditions
Column : MCI GEL™ CK06SC
8mm I.D.×500mm
Eluent : H_2O
Flow rate : 1.0 mℓ/min
Column temp. : 75°C
Detection : RI
Injection volume : 20μL



●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.

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. 2-20

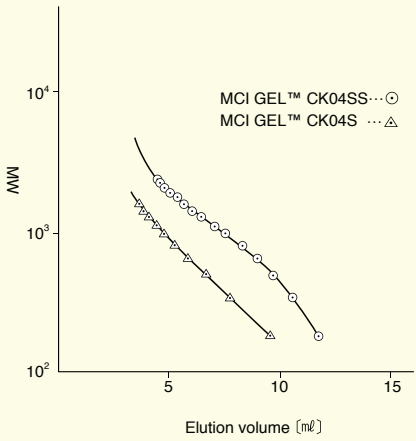
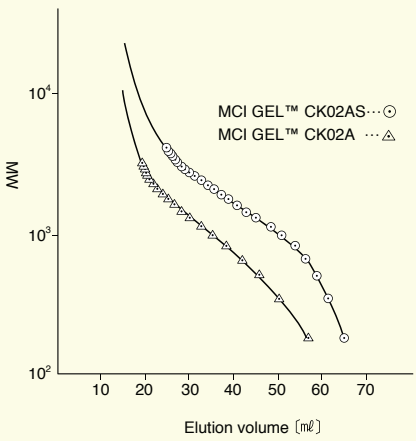


Fig. 2-21



Comparison data of malto-oligosaccharides

Fig. 2-22 MCI GEL™ CK04S
10mm I.D.×200mm

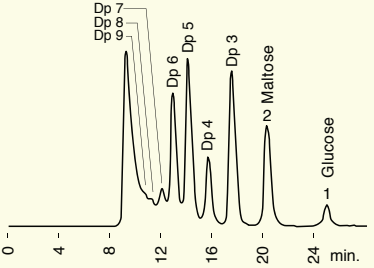


Fig. 2-23 MCI GEL™ CK04SS
10mm I.D.×200mm

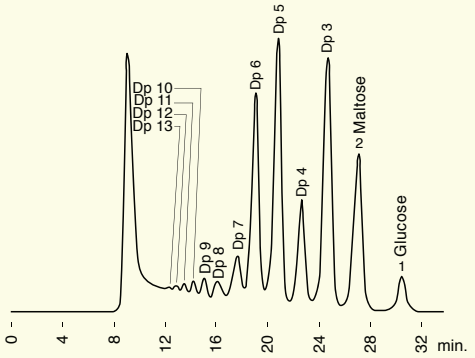


Fig. 2-24 MCI GEL™ CK02A
20mm I.D.×250mm

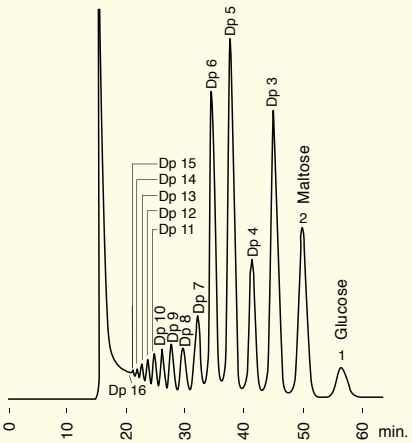
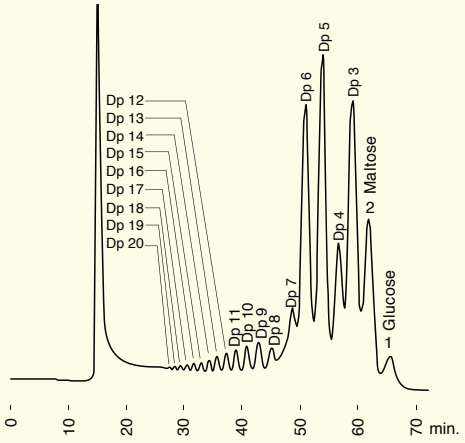


Fig. 2-25 MCI GEL™ CK02AS
20mm I.D.×250mm



Conditions
Eluent : H_2O
Flow rate : 0.4 mℓ/min (Fig. 2-22, 2-23, 2-26, 2-27)
1.0 mℓ/min (Fig. 2-24, 2-25, 2-28)
Column temp. : 85°C
Detection : RI

Comparison data of authentic malto-oligosaccharides samples

Fig. 2-26 MCI GEL™ CK04S
10mm I.D.×200mm

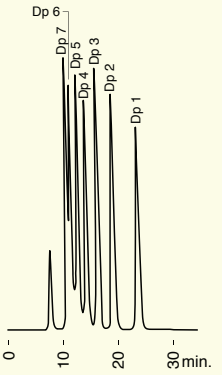


Fig. 2-27 MCI GEL™ CK04SS
10mm I.D.×200mm

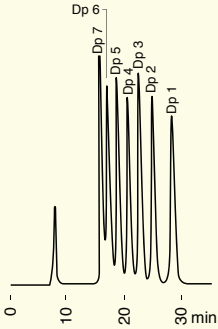
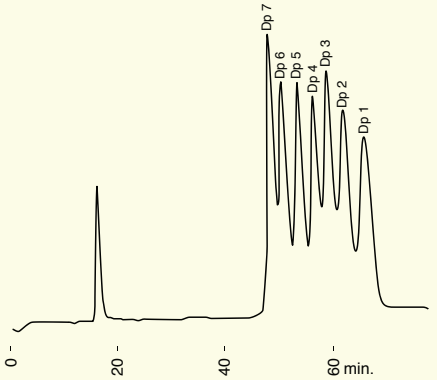


Fig. 2-28 MCI GEL™ CK02AS
20mm I.D.×250mm



Application data of CK04S

Fig. 2-29 Honey

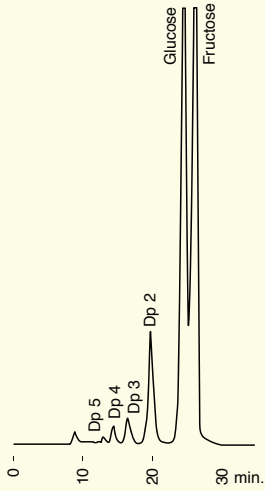


Fig. 2-30 Jam

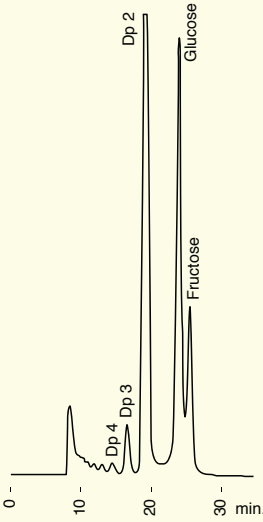
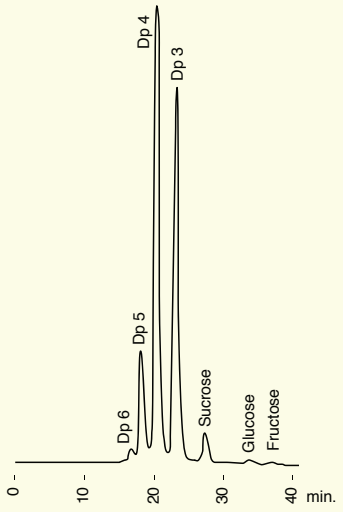


Fig. 2-31 Fructo-oligosaccharides



Conditions
Column : MCI GEL™ CK04S
10mm I.D.×200mm
Eluent : H_2O
Flow rate : 0.4 mℓ/min (Fig. 2-29, 2-30) 0.3 mℓ/min (Fig. 2-31)
Column temp. : 85°C (Fig. 2-29, 2-30) 45°C (Fig. 2-31)
Detection : RI

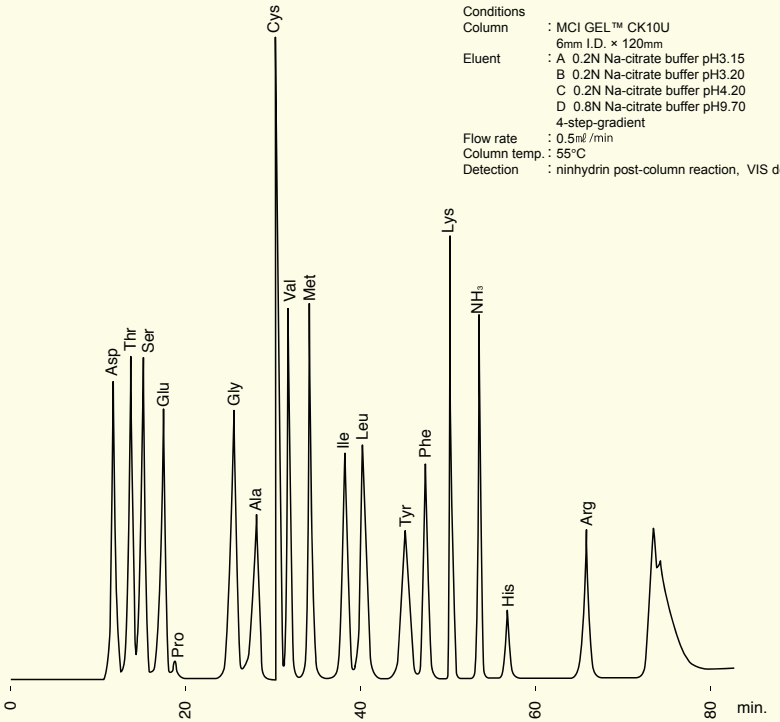
2 MCI GEL™ CK10U

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

CK10U 6×120

Separation of amino acids

Fig. 2-32 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. 2-33 Valine, β-Alanine

Conditions
Column : MCI GEL™ CK10U
6mm I.D.×120mm
Eluent : 0.3M Na-phosphate pH5.0
Flow rate : 0.5 mℓ/min
Column temp. : 40°C
Detection : 210nm
Sample : 1. Valine
2. β-Alanine

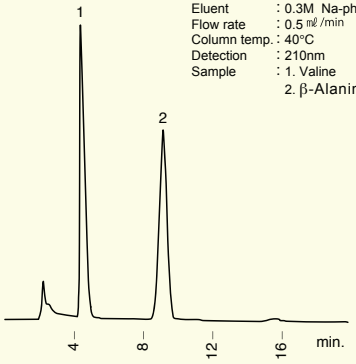


Fig. 2-34 γ-Aminobutyric acid

Conditions
Column : MCI GEL™ CK10U
6mm I.D.×120mm
Eluent : 0.2N Na-Citrate buffer pH5.2
Flow rate : 0.5 mℓ/min
Column temp. : 55°C
Detection : 570nm

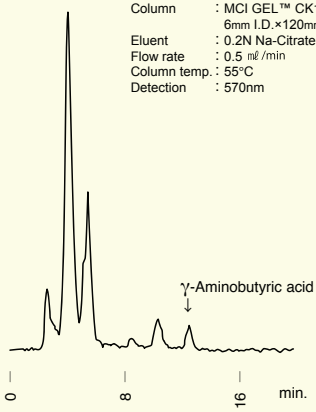


Fig. 2-35 cyclic amino acids

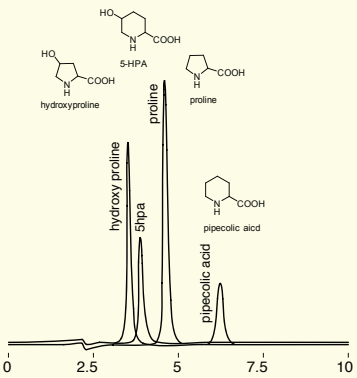


Fig. 2-36 alkyl amino acid

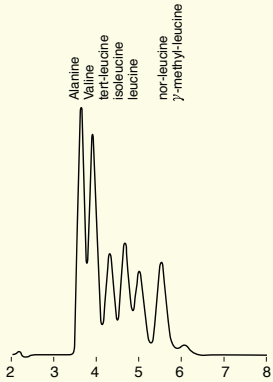
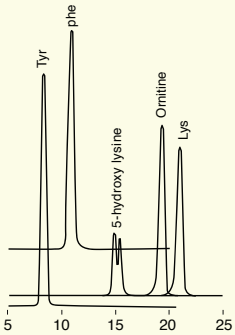


Fig. 2-37 basic amino acid and aromatic amino acids



Conditions
Column : MCI GEL™ CK10U
6mm I.D.×120mm
Eluent : 0.3M $NaSO_4$ (pH5.7)
Flow : 0.5 mℓ/min
Temp. : 60 degree
UV : 210nm

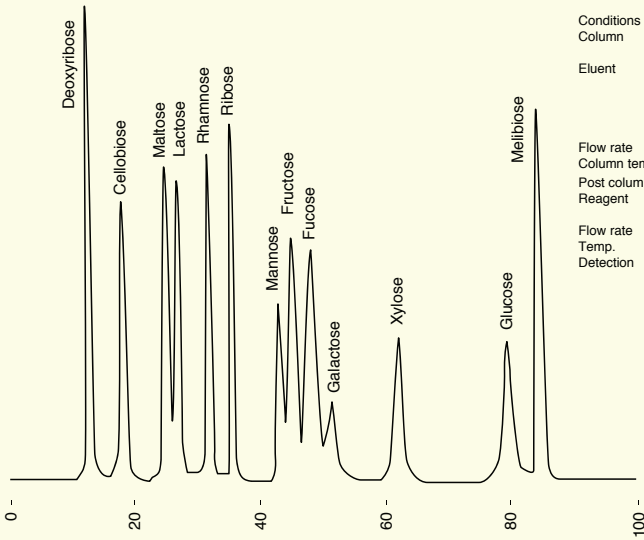
2 MCI GEL™ CA08F

Anion exchange column
applications; sugars, carboxylic acids, nucleotides

MCI GEL™ CA08F packed column has been designed for the analysis of nucleotides, sugars, and organic acids by anion exchange chromatography mode.
This column will provide excellent separation and short analysis time.

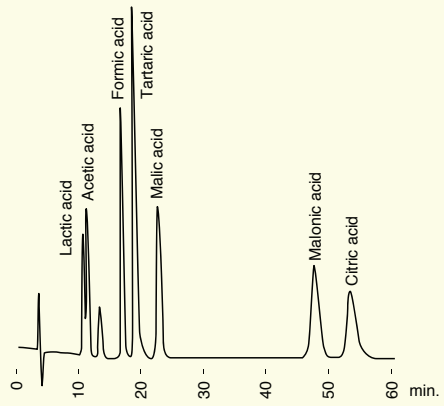
Application data of CA08F

Fig. 2-38 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. 2-39 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. 2-40 Carboxylic acids

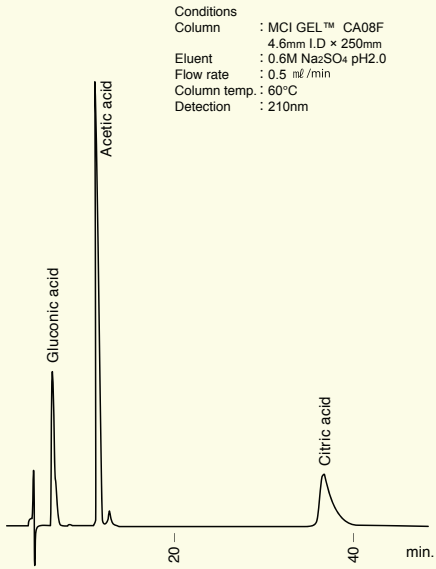


Fig. 2-41 Organic acid

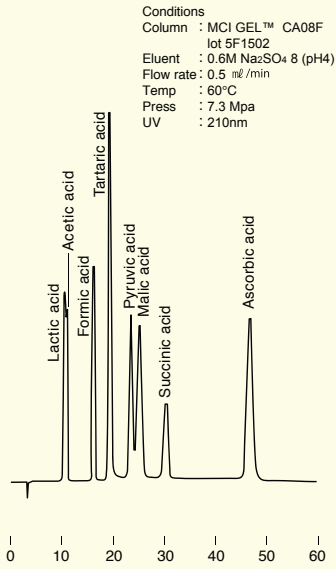
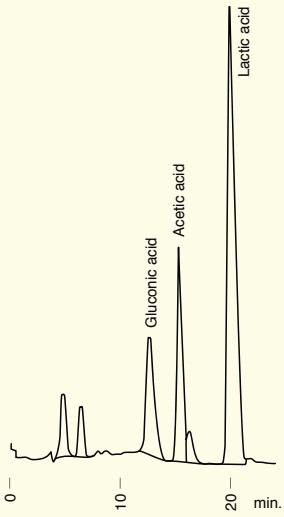


Fig. 2-42 Carboxylic acids



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

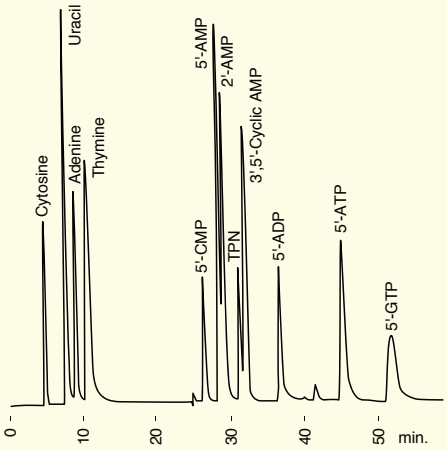
2 MCI GEL™ CDR10

High porous type anion exchange column

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.

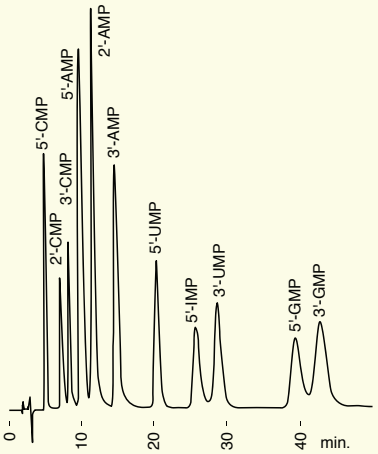
Application data of CDR10

Fig. 2-43 Nucleic acids and related substances



Conditions
Column : MCI GEL™ CDR10 4.6mm I.D.×250mm
Eluent : A H_2O
B 6M Acetate buffer pH4.4
A→B 30min linear gradient
Flow rate : 0.5 mℓ/min
Column temp. : 60°C
Detection : 254nm

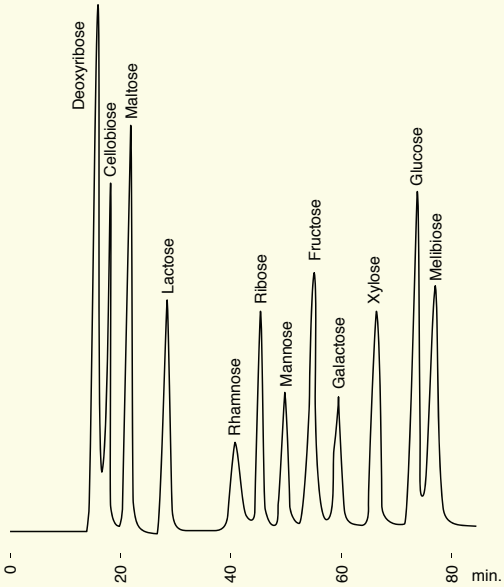
Fig. 2-44 Mono-nucleotides



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

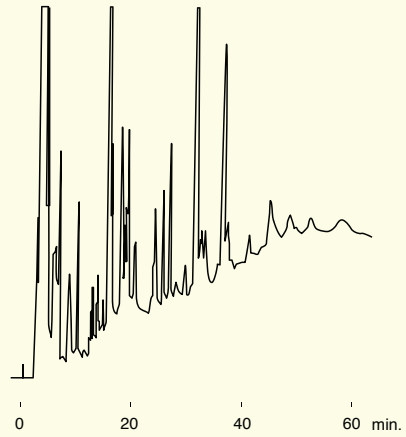
Application data of CDR10

Fig. 2-45 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. 2-46 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