07

Reversed-Phase Columns (Other than ODS)

Types and characteristics of reversed-phase columns

YMC reversed-phase columns include a variety of columns other than ODS, enabling column selection from a wide range of products to suit the sample characteristics.

Elution behavior dependent on alkyl chain length

In reversed-phase chromatography, retention due to hydrophobicity generally depends directly on the carbon number of the stationary phase. The degree of retention due to hydrophobicity of the stationary phase can generally be listed in descending order by column type as ODS>C8>C4>TMS. Stationary phases with low hydrophobicity can be used effectively to reduce analysis time for samples having too strong of a retention on ODS. Stationary phases with low hydrophobicity are also useful for samples that are slightly soluble in organic solvents and need to be analyzed with mobile phase containing a low concentration of organic solvents.

Elution behavior affected by other factors

Phenyl, PFP, and CN have available π electrons derived from their functional groups. Phenyl, PFP, and CN sometimes show different separation characteristics from stationary phases that are chemically bonded with straight alkyl chains. Since CN has medium-polar functional groups, it can be used in both normal-phase and reversed-phase separation modes, depending on the mobile phase used.

Types of reversed-phase columns (I)

ODS	$-C_{18}H_{37}$	Retention due to hydrophobicity High ↕ Low
C8	$-C_8H_{17}$	
C4	$-C_4H_9$	
TMS	$-CH_3$	

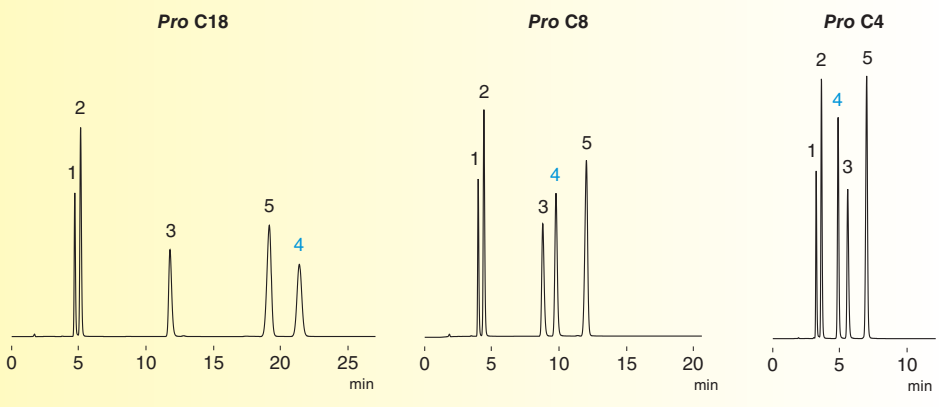
Types of reversed-phase columns (II)

Phenyl (Ph)		π electrons available
PFP		π electrons available
CN	$-(CH_2)_3-CN$	π electrons available Can be used also in normal-phase

Types and characteristics of reversed-phase columns (other than ODS)

Product name		Pore size (Å)	Particle size (μm)	C%	Silanol treatment	Usable pH range	Characteristics	Pages
YMC-Triart	C8	120	1.9, 3, 5	17	Yes	1.0 ~ 12.0	● Versatile hybrid silica based C8 column ● Ideal for separations of isomers or structural analogs	63
	Phenyl			17		1.0 ~ 10.0	● Versatile hybrid silica based Phenyl column ● Ideal for separations of aromatic compounds or compounds having long conjugated system	64
	PFP			15	No	1.0 ~ 8.0	● Versatile hybrid silica based PFP column ● Ideal for separations of polar compounds or isomers	65
Meteoric Core C8		80	2.7	5	Yes	1.5 ~ 9.0	● Core-Shell type C8 ● Ultra fast analysis and excellent resolution	72~75
Pro series	*Pro* C8	120	3, 5	10	Yes	2.0 ~ 7.5	● Processed with advanced endcapping technology ● Superior separation of basic compounds	96
	Pro C4	120	3, 5	7			● Processed with advanced endcapping technology ● Different selectivity from ODS	
YMC-Pack series	C_8	120	3, 5,10	10	Yes		● Moderate hydrophobicity ● Useful for separation of proteins and peptides	97
		200	5,10	7				
		300	5,10	4				
	C_4	120	3, 5,10	7			● Lower hydrophobicity than ODS and C8 ● Useful for separation of proteins and peptides	97
		200	5,10	5				
		300	5,10	3				
	TMS	120	3, 5,10	4			● Reversed-phase packing material with the lowest hydrophobicity	98
	Ph	120	3, 5,10	9			● Reversed-phase packing material with π electrons	98
	CN	120	3, 5,10	7			● Can be used in both normal-phase and reversed-phase modes	99
		300	5	3				
	PROTEIN-RP	200	5	4	—	1.5 ~ 7.5	● Useful for separation of proteins and peptides	99
YMCbasic		200	3, 5	7	Yes	2.0 ~ 7.5	● Superior separation of basic compounds ● Useful for separation of proteins and peptides	100
YMC Carotenoid		—	3, 5	—	—	2.0 ~ 7.5	● Useful for carotenoids separation	100

Elution behavior dependent on alkyl chain length

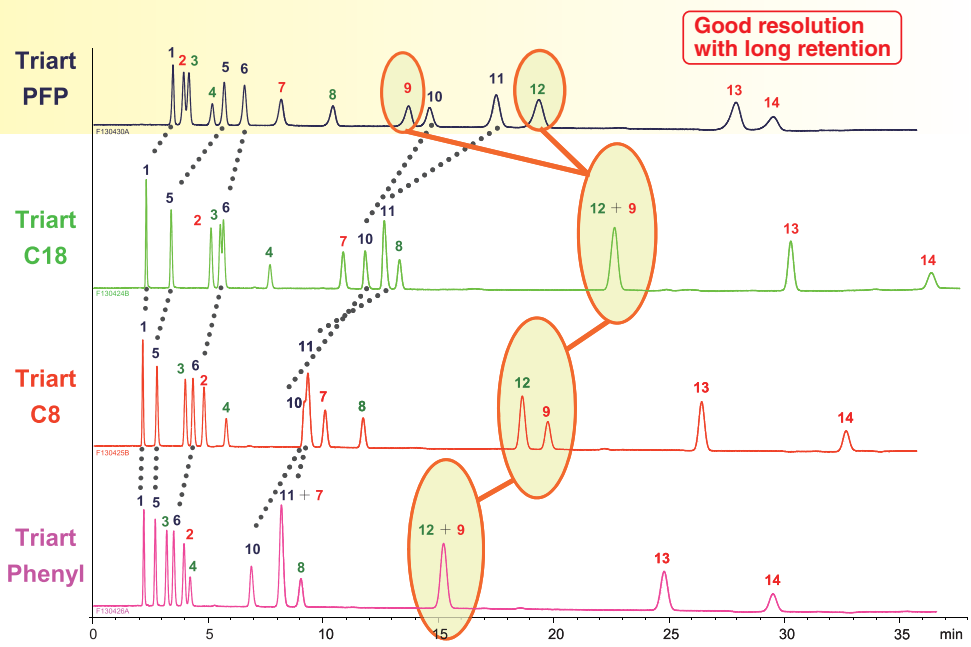


1. Toluene
2. Deoxycorticosterone acetate
3. Imipramine hydrochloride
4. Triphenylene
5. *n*-Amylbenzene

Column	: 150 X 4.6 mmI.D.
Eluent	: 20 mM KH_2PO_4-K_2HPO_4 (pH 6.9)/methanol (25/75)
Flow rate	: 1.0 mL/min
Temperature	: 37°C
Detection	: UV at 254 nm

In this example, the retention behavior of a variety of compounds is shown to be dependent on the alkyl chain length of the stationary phase. Shorter alkyl chain lengths like C4 show reduced retention for neutral compounds due to the diminished hydrophobicity of the C4 stationary phase relative to longer alkyl chains phases like C8 and C18. The differences in the selectivity of stationary phases of different alkyl chain length is also illustrated for triphenylene, a planar molecule with restricted rotational movement. Triphenylene shows much shorter retention on C4 relative to C8 and C18 than would be expected on the basis of hydrophobicity of the stationary phase. Note the difference in elution order for triphenylene relative to imipramine and amylbenzene for this mixture on this series of stationary phases.

Comparison of separation selectivity among YMC-Triart reversed-phase columns



Separation selectivity of YMC-Triart reversed-phase columns is compared on analysis of 14 biologically active amines and their related compounds. Retention time of each compound is summarized by type of compounds. As shown, Triart PFP column shows strong retention of basic compounds (peak 1, 5, 6, 10, 11). It is considered that basic compounds which has electron-donating characteristic and polarised PFP group/silanol group are strongly interacted, and as a result, Triart PFP shows longer retention time.

Biologically active amines and their related compounds

1. Noradrenaline HCl (NA) (Norepinephrine HCl)
2. 3,4-Dihydroxymandelic acid (DOMA)
3. 3,4-Dihydroxyphenylalanine (DOPA)
4. Tyrosine (Tyr)
5. Adrenaline HCl (A) (Epinephrine HCl)
6. Dopamine HCl (DA)
7. Vanillylmandelic acid (VMA)
8. 3-Methoxy-4-hydroxy phenylglycol (MHPG)
9. 3,4-Dihydroxyphenylacetic acid (DOPAC)
10. 3-Methoxytyramine HCl (3MT)
11. 5-Hydroxytryptamine HCl (5HT) (Serotonin HCl)
12. Tryptophan (Trp)
13. 5-Hydroxyindoleacetic acid (5HIAA)
14. Homovanillic acid (HVA)

Column	: 5 µm, 150 X 3.0 mmI.D.
Eluent	: A) 10 mM formic acid B) methanol containing 10 mM formic acid 0-20%B (0-30 min), 20%B (30-35 min)
Flow rate	: 0.425 mL/min
Temperature	: 25°C
Detection	: UV at 280 nm

Analytical columns

YMC-Pack *Pro* C8, C4

- Superior separation of basic compounds
- Excellent reproducibility
- Utilizes highly pure silica gel base

C8 ■ Pore size : 120 Å
■ Carbon content : 10%
■ Usable pH range : 2.0~7.5
■ USP L7

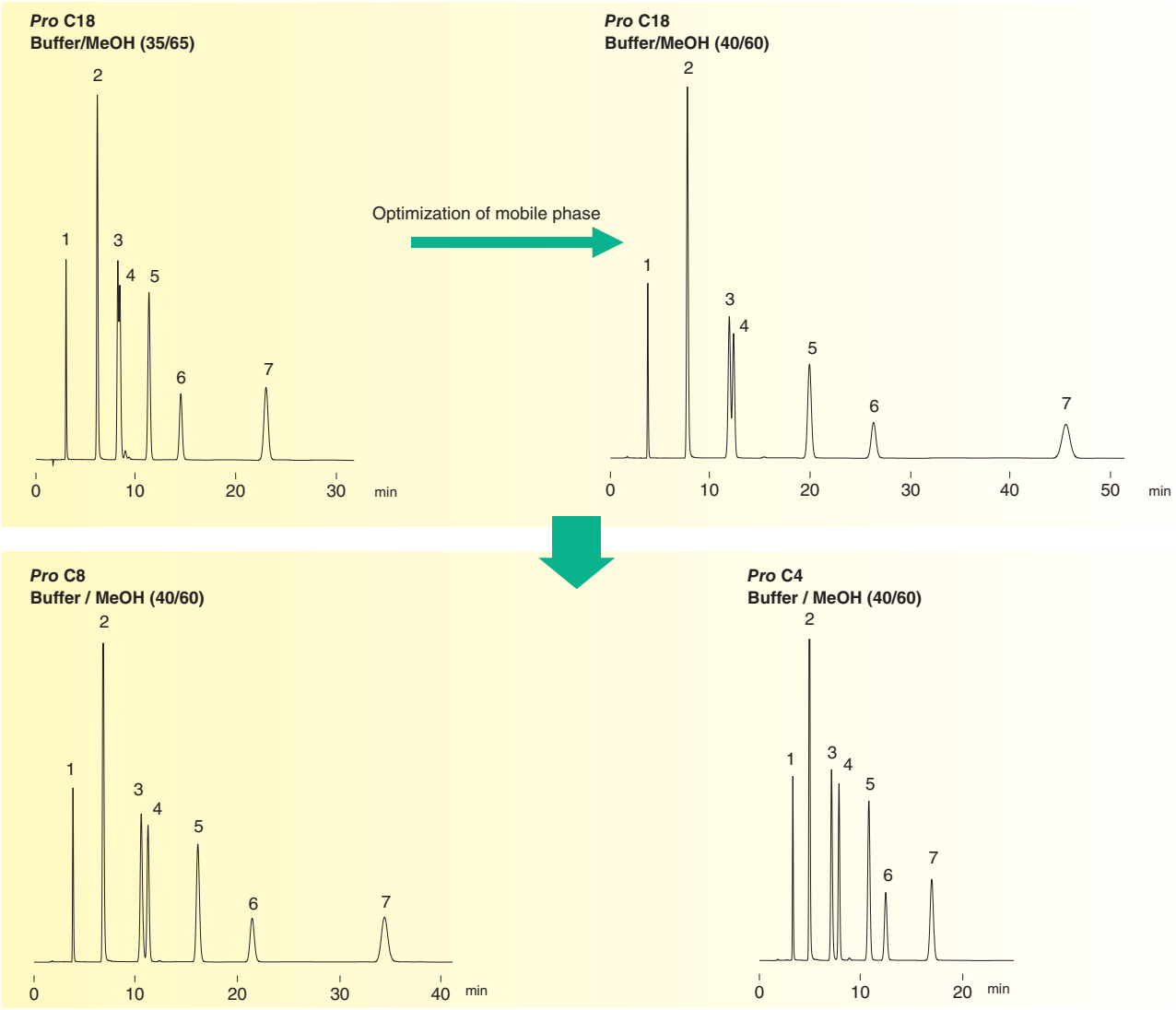
C4 ■ Pore size : 120 Å
■ Carbon content : 7%
■ Usable pH range : 2.0~7.5
■ USP L26

Highly endcapped C8 and C4 reversed-phase columns

YMC-Pack *Pro* C8 and C4 are highly appropriate for basic compounds since more advanced endcapping technology is used for processing of their residual silanol groups that are likely to affect quality. The YMC-Pack *Pro* C8 and C4 stationary phase surface hydrophobicity is lower than that of ODS, making YMC-Pack *Pro* C8 and C4 useful for quick analysis of compounds that differ greatly in hydrophobicity. The separation behavior of hydrophilic compounds or planar compounds on YMC-Pack *Pro* C8 and C4 also differs from that on ODS, making YMC-Pack *Pro* C8 and C4 useful for separating compounds in cases where separation optimization is difficult to achieve using ODS.

Optimization of separation using *Pro* C8 and *Pro* C4

Separation of antiarrhythmics



1. Phenytoin
2. Propranolol HCl
3. Quinidine
4. Lidocaine
5. Diltiazem HCl
6. Verapamil HCl
7. Nicardipine HCl

Column	: 150 X 4.6 mmI.D.
Eluent	: 20 mM KH_2PO_4-K_2HPO_4 (pH 6.9)/methanol
Flow rate	: 1.0 mL/min
Temperature	: 37°C
Detection	: UV at 220 nm

Retention times of analytes on *Pro* C8 and *Pro* C4 tend to be shorter than those on C18. When alkyl chain lengths of packing material functional groups are shorter, hydrogen-bonding capacities tend to be greater; therefore, not only retention time, but also separation selectivity of *Pro* C8 and *Pro* C4 may differ from those of C18. Separation optimization is difficult to achieve for antiarrhythmics using *Pro* C18, even if the mobile phase is changed. In contrast, C8 and C4 can completely separate antiarrhythmics in a short time. As shown above, C8 and C4 may be useful in cases where separation optimization is difficult to achieve using C18.

Analytical columns

YMC-Pack C_8

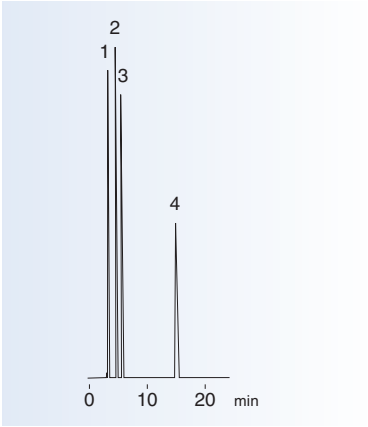
- Stationary phase with lower hydrophobicity than ODS
- Useful for separating samples with relatively high hydrophobicity
- Useful for separation of proteins and peptides

- Pore size : 120, 200, 300 Å
- Carbon content : 10%, 7%, 4%
- Usable pH range : 2.0~7.5
- USP L7

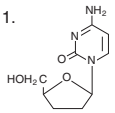
Reversed-phase column with moderate hydrophobicity

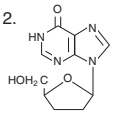
The hydrophobicity of YMC-Pack C_8 is moderate for a reversed-phase packing material. Retention times of samples on YMC-Pack C_8 tend to be shorter than those on ODS stationary phase. The moderate hydrophobicity of YMC-Pack C_8 makes it useful for separating samples with relatively high hydrophobicity.

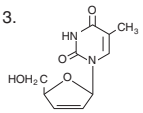
Application (K930311A)

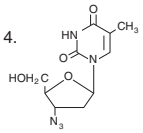


Anti-HIV nucleoside derivatives

1. 
ddC

2. 
ddI

3. 
d4T

4. 
AZT

Column	: YMC-Pack C_8 (5 µm, 120 Å) 150 X 4.6 mmI.D.
Eluent	: methanol/10 mM KH_2PO_4 (10/60)
Flow rate	: 1.0 mL/min
Temperature	: 37°C
Detection	: UV at 254 nm

Analytical columns

YMC-Pack C_4

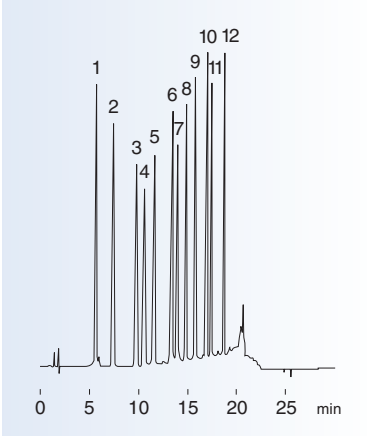
- Stationary phase with low hydrophobicity
- Different separation characteristics from ODS
- Useful for separation of proteins and peptides

- Pore size : 120, 200, 300 Å
- Carbon content : 7%, 5%, 3%
- Usable pH range : 2.0~7.5
- USP L26

Reversed-phase column with shorter alkyl chain

The YMC-Pack C_4 stationary phase surface hydrophobicity is lower than that of both ODS and C_8. Retention times of samples on YMC-Pack C_4 therefore tend to be shorter than those on ODS or C_8. Separation characteristics of YMC-Pack C_4 also differ from those of ODS. YMC-Pack C_4 achieves better separation than ODS for some types of samples.

Application (T920302A)



2,4-DNPH derivatives of aldehydes and ketones

1. Formaldehyde 2,4-DNPH
2. Acetaldehyde 2,4-DNPH
3. Acetone 2,4-DNPH
4. Acrolein 2,4-DNPH
5. Propionaldehyde, 2,4-DNPH
6. Crotonaldehyde 2,4-DNPH
7. Methylethylketone 2,4-DNPH
8. Isobutyraldehyde 2,4-DNPH
9. Benzaldehyde 2,4-DNPH
10. *n*-Valeraldehyde 2,4-DNPH
11. *p*-Tolualdehyde 2,4-DNPH
12. Capronaldehyde 2,4-DNPH

Column	: YMC-Pack C_4 (5 µm, 120 Å) 150 X 4.6 mmI.D.
Eluent	: A) tetrahydrofuran/water (10/90) B) acetonitrile 35%B (0-7 min), 35-65%B (7-18 min, linear), 100%B (18-19 min), 35%B (19-35 min)
Flow rate	: 1.5 mL/min
Temperature	: 30°C
Detection	: UV at 360 nm

Analytical columns

YMC-Pack TMS

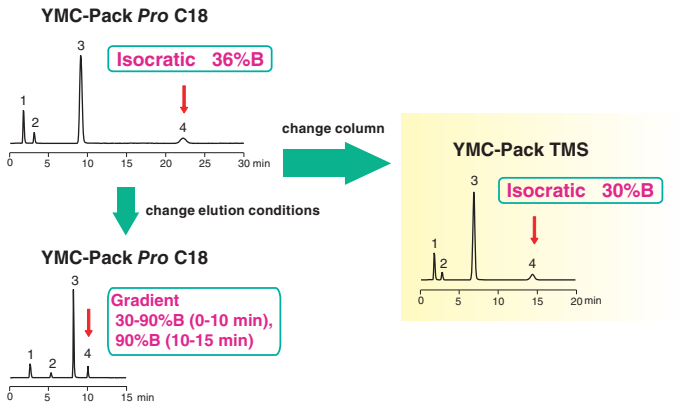
- Stationary phase with the lowest hydrophobicity among reversed-phase packing materials
- Different separation characteristics from ODS

- Pore size : 120 Å
- Carbon content : 4%
- Usable pH range : 2.0~7.5
- USP L13

Reversed-phase column with the lowest hydrophobicity

YMC-Pack TMS shows lower retention due to hydrophobic interaction than other packing materials, and it is useful for eluting highly hydrophobic compounds in a short time. In addition, it can sometimes achieve greater retention and better separation of hydrophilic compounds than other reversed-phase columns.

Shorten analysis time using TMS



Soy isoflavones

1. Daidzin
2. Genistin
3. Daidzein
4. Genistein

Column	: 50 X 2.0 mmI.D.
Eluent	: A) water/formic acid (100/0.05) B) acetonitrile/water/formic acid (50/50/0.05)
Flow rate	: 0.2 mL/min
Temperature	: 37°C
Detection	: ESI positive mode

TMS enables analysis time of highly hydrophobic compounds to shorten.

Analytical columns

YMC-Pack Ph

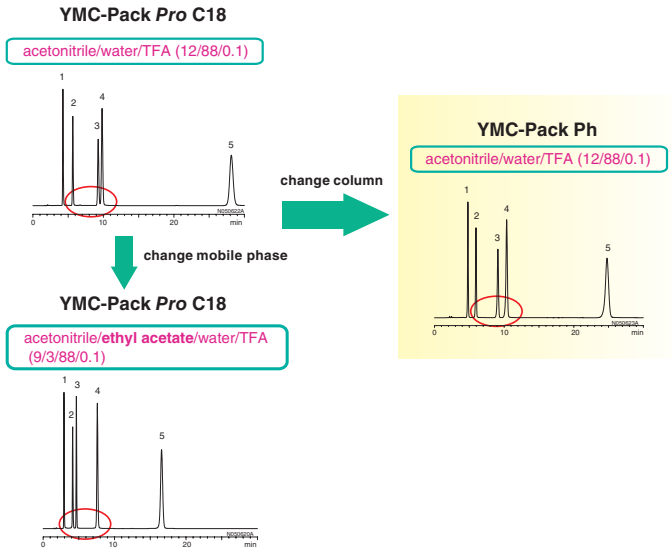
- Reversed-phase column with π electrons
- Unique selectivity due to π-π interaction
- Useful in cases where separation optimization is difficult to achieve using ODS

- Pore size : 120 Å
- Carbon content : 9%
- Usable pH range : 2.0~7.5
- USP L11

Different selectivity from ODS

YMC-Pack Ph has π electrons of phenyl group. YMC-Pack Ph shows different separation characteristics from alkyl-silica stationary phases including ODS for separation of solutes such as aromatic compounds, since π-π interaction between the stationary phase and solutes, as well as hydrophobic interaction, contribute to the separation.

Establishment of simple conditions using Ph



Catechins

1. (-)-Epigallocatechin
2. (+)-Catechin
3. (-)-Epicatechin
4. (-)-Epigallocatechin gallate
5. (-)-Epicatechin gallate

Column	: 150 X 4.6 mmI.D.
Flow rate	: 1.0 mL/min
Temperature	: 37°C
Detection	: UV at 280 nm

Ph is suitable for separating catechins with simple mobile phase, whereas if using ODS and optimizing analysis conditions, the mobile phase, addition with ethyl acetate, is complicated.

Analytical columns

YMC-Pack CN

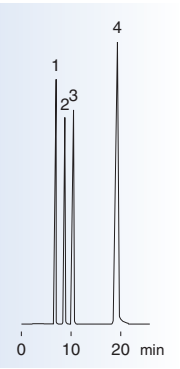
- Normal-phase and reversed-phase modes are selectable according to the purpose of analysis
- Low hydrophobicity
- Unique selectivity due to cyano group

- Pore size : 120, 300 Å
- Carbon content : 7%, 3%
- Usable pH range : 2.0~7.5
- USP L10

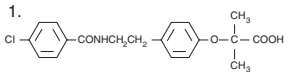
Column can be used in both normal-phase and reversed-phase modes

YMC-Pack CN can be used in both normal-phase and reversed-phase modes, since it has cyanopropyl group of medium polarity chemically bonded to the stationary phase. It can be used in normal phase mode with low-polarity mobile phase such as hexane. It can also be used in reversed-phase mode with highly-polar mobile phase such as methanol and water. The hydrophobicity of YMC-Pack CN is relatively low for a reversed-phase packing material, and it shows different selectivity from ODS due to π electrons of the cyano groups. YMC-Pack CN is useful for shortening analysis time when retention time is too long with ODS and useful in cases where separation optimization is difficult to achieve using ODS.

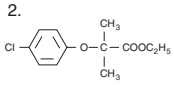
Application (S931025E)



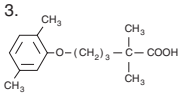
Anti-hyperlipidemia drugs

1. 

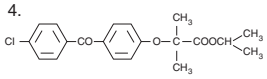
Bezafibrate

2. 

Clofibrate

3. 

Gemfibrozil

4. 

Fenofibrate

Column	: YMC-Pack CN (5 µm, 120 Å) 150 X 4.6 mmI.D.
Eluent	: acetonitrile/methanol/water/acetic acid (20/20/60/1)
Flow rate	: 1.0 mL/min
Temperature	: 37°C
Detection	: UV at 275 nm

Analytical columns

YMC-Pack PROTEIN-RP

- Improved recovery of proteins or peptides
- Improved durability when used with TFA solution
- Enables elution of high molecular weight proteins

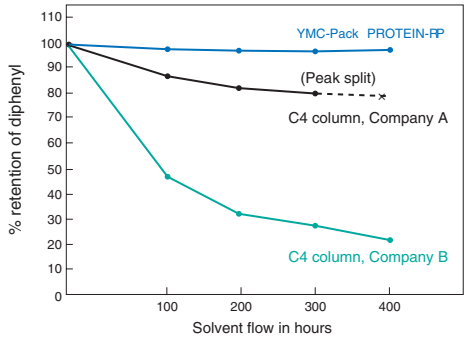
- Pore size : 200 Å
- Carbon content : 4%
- Usable pH range : 1.5~7.5
- USP L26

Reversed-phase column for separation of proteins or peptides

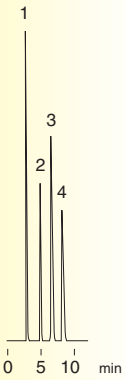
YMC-Pack PROTEIN-RP is a reversed-phase column utilizing a silica gel base. It contains a stationary phase, specifically designed for separation of proteins or peptides. Problems that are associated with conventional reversed-phase columns with short alkyl chain lengths are minimized. Robust column lifetime and excellent recovery of hydrophobic proteins are typically possible with this phase.

Improved durability when used with TFA solution

0.1%TFA condition

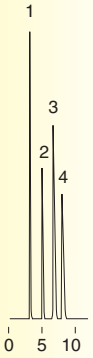


<Prior to flow>



Theoretical plate number (4) = 14,300

<After 500 hours>



Theoretical plate number (4) = 13,800

1. Uracil
2. Benzene
3. Naphthalene
4. Diphenyl

<Flow conditions>

Eluent	: water/TFA (100/0.1)
Flow rate	: 1.0 mL/min
Temperature	: ambient

<Measurement conditions>

Column	: YMC-Pack PROTEIN-RP 250 X 4.6 mmI.D.
Eluent	: acetonitrile/water (40/60)
Flow rate	: 1.0 mL/min
Temperature	: 30°C
Detection	: UV at 254 nm, 0.32 AUFS

Test results of the stability of stationary phase with 0.1% aqueous TFA is shown adove. Retention of diphenyl on C4 columns manufactured by other companies greatly decreases as time passes. This is caused by cleavage of butyl groups from the packing material due to acid hydrolysis. Retention of diphenyl on PROTEIN-RP is shown to be stable after 500 hours of mobile phase flow.

Analytical columns

YMCbasic

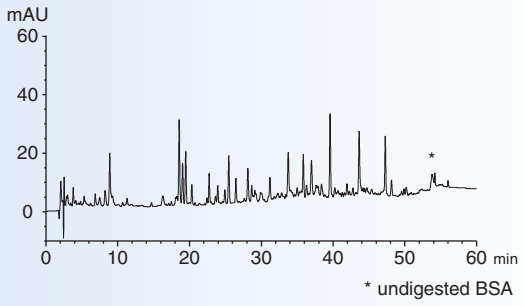
- Superior separation of basic compounds
- Useful for separation of peptides
- Secondary interaction minimized as much as possible

- Pore size : 200 Å
- Carbon content : 7%
- Usable pH range : 2.0~7.5
- USP L7

Column for separation of basic compounds

YMCbasic is a reversed-phase silica based C8 column designed for separation of basic compounds, including pharmaceutical products. It is highly evaluated as a base-deactivated phase in Europe and the U.S. It offers superior separation of acidic compounds as well as basic compounds. It is suitable for separating peptides with molecular weights in the range of several thousands, such as insulin.

Application (N061027C)



Tryptic digest of BSA

Column	: YMCbasic (5 µm) 150 X 2.0 mmI.D.
Eluent	: A) water/TFA (100/0.1) B) acetonitrile/TFA (100/0.1) 5-35%B (0-50 min), 35-45%B (50-55 min), 45%B (55-60 min)
Flow rate	: 0.2 mL/min
Temperature	: 37°C
Detection	: UV at 220 nm

Analytical columns

YMC Carotenoid

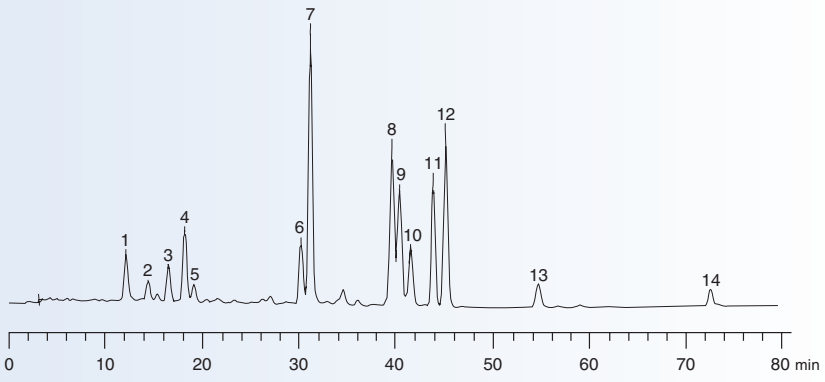
- Resolves polar and nonpolar geometric carotenoid isomers
- Separates carotenoids in blood samples, food products, natural product extracts, and commercial preparations
- Operates with low aqueous or non aqueous mobile phases desirable in LC/MS and prep fraction recovery

- Usable pH range : 2.0~7.5
- USP L62

Carotenoid analytical column

YMC Carotenoid is C30 bonded silica based reversed-phase column. It is for carotenoid analysis and useful for separation of geometric isomers.

Application (A110401A)



Carotene and xanthophyll

1. Astaxanthin
2. Capsanthin
3. Lutein
4. Zeaxanthin
5. Canthaxanthin
6. β -Cryptoxanthin
7. Echinenone
8. 15-*cis* β -Carotene
9. 13-*cis* β -Carotene
10. α -Carotene
11. *trans* β -Carotene
12. 9-*cis* β -Carotene
13. δ -Carotene
14. Lycopene

Column	: YMC Carotenoid 250 X 4.6 mmI.D.
Eluent	: A) methanol/MTBE*/H_2O (81/15/4) B) methanol/MTBE*/H_2O (6/90/4) 0-100%B (0-90 min)
Flow rate	: 1.0 mL/min
Temperature	: ambient
Detection	: UV at 450 nm

*methyl *tert*-butyl ether

Ordering Information -Columns-

YMC-Pack *Pro* C8

Phase dimension	Column I.D. (mm)	Column length (mm)					Guard cartridges	
		50	75	100	150	250	I.D. (mm)	10 mm length
120 Å 3 µm	2.0	OS12S03-0502WT	OS12S03-L502WT	OS12S03-1002WT	OS12S03-1502WT	—	2.1	OS12S03-01Q1GC
	3.0	OS12S03-0503WT	—	OS12S03-1003WT	OS12S03-1503WT	—	3.0	OS12S03-0103GC
	4.6	OS12S03-0546WT	OS12S03-L546WT	OS12S03-1046WT	OS12S03-1546WT	—	4.0	OS12S03-0104GC
120 Å 5 µm	2.0	OS12S05-0502WT	OS12S05-L502WT	OS12S05-1002WT	OS12S05-1502WT	—	2.1	OS12S05-01Q1GC
	3.0	OS12S05-0503WT	—	—	OS12S05-1503WT	OS12S05-2503WT	3.0	OS12S05-0103GC
	4.6	OS12S05-0546WT	OS12S05-L546WT	OS12S05-1046WT	OS12S05-1546WT	OS12S05-2546WT	4.0	OS12S05-0104GC
	6.0	—	—	—	OS12S05-1506WT	—		

YMC-Pack *Pro* C4

Phase dimension	Column I.D. (mm)	Column length (mm)					Guard cartridges	
		50	75	100	150	250	I.D. (mm)	10 mm length
120 Å 3 µm	2.0	BS12S03-0502WT	BS12S03-L502WT	BS12S03-1002WT	BS12S03-1502WT	—	2.1	BS12S03-01Q1GC
	3.0	BS12S03-0503WT	—	BS12S03-1003WT	BS12S03-1503WT	—	3.0	BS12S03-0103GC
	4.6	BS12S03-0546WT	BS12S03-L546WT	BS12S03-1046WT	BS12S03-1546WT	—	4.0	BS12S03-0104GC
120 Å 5 µm	2.0	BS12S05-0502WT	BS12S05-L502WT	BS12S05-1002WT	BS12S05-1502WT	—	2.1	BS12S05-01Q1GC
	3.0	BS12S05-0503WT	—	—	BS12S05-1503WT	BS12S05-2503WT	3.0	BS12S05-0103GC
	4.6	BS12S05-0546WT	BS12S05-L546WT	BS12S05-1046WT	BS12S05-1546WT	BS12S05-2546WT	4.0	BS12S05-0104GC
	6.0	—	—	—	BS12S05-1506WT	—		

YMC-Pack C_8

Phase dimension	Column I.D. (mm)	Column length (mm)					Guard cartridges	
		50	75	100	150	250	I.D. (mm)	10 mm length
120 Å 3 µm	2.0	OC12S03-0502WT	OC12S03-L502WT	OC12S03-1002WT	OC12S03-1502WT	—	2.1	OC12S03-01Q1GC
	3.0	OC12S03-0503WT	—	OC12S03-1003WT	OC12S03-1503WT	—	3.0	OC12S03-0103GC
	4.6	—	—	OC12S03-1046WT	OC12S03-1546WT	—	4.0	OC12S03-0104GC
120 Å 5 µm	2.0	—	—	—	OC12S05-1502WT	OC12S05-2502WT	2.1	OC12S05-01Q1GC
	4.6	—	OC12S05-L546WT	OC12S05-1046WT	OC12S05-1546WT	OC12S05-2546WT	4.0	OC12S05-0104GC
	6.0	—	—	OC12S05-1006WT	OC12S05-1506WT	OC12S05-2506WT		
	10	—	—	—	OC12S05-1510WT	OC12S05-2510WT	10	OC12S05-0110CC
200 Å 5 µm	4.6	—	—	—	OC20S05-1546WT	OC20S05-2546WT	4.0	OC20S05-0104GC
300 Å 5 µm	2.0	—	—	—	OC30S05-1502WT	OC30S05-2502WT	2.1	OC30S05-01Q1GC
	4.6	—	OC30S05-L546WT	OC30S05-1046WT	OC30S05-1546WT	OC30S05-2546WT	4.0	OC30S05-0104GC
	6.0	—	—	OC30S05-1006WT	OC30S05-1506WT	OC30S05-2506WT		
	10	—	—	—	OC30S05-1510WT	OC30S05-2510WT	10	OC30S05-0110CC

YMC-Pack C_4

Phase dimension	Column I.D. (mm)	Column length (mm)					Guard cartridges	
		50	75	100	150	250	I.D. (mm)	10 mm length
120 Å 3 µm	2.0	BU12S03-0502WT	BU12S03-L502WT	BU12S03-1002WT	BU12S03-1502WT	—	2.1	BU12S03-01Q1GC
	3.0	BU12S03-0503WT	—	BU12S03-1003WT	BU12S03-1503WT	—	3.0	BU12S03-0103GC
	4.6	—	—	BU12S03-1046WT	BU12S03-1546WT	—	4.0	BU12S03-0104GC
120 Å 5 µm	2.0	—	—	—	BU12S05-1502WT	BU12S05-2502WT	2.1	BU12S05-01Q1GC
	4.6	—	BU12S05-L546WT	BU12S05-1046WT	BU12S05-1546WT	BU12S05-2546WT	4.0	BU12S05-0104GC
	6.0	—	—	BU12S05-1006WT	BU12S05-1506WT	BU12S05-2506WT		
	10	—	—	—	BU12S05-1510WT	BU12S05-2510WT	10	BU12S05-0110CC
300 Å 5 µm	2.0	—	—	—	BU30S05-1502WT	BU30S05-2502WT	2.1	BU30S05-01Q1GC
	4.6	—	BU30S05-L546WT	BU30S05-1046WT	BU30S05-1546WT	BU30S05-2546WT	4.0	BU30S05-0104GC
	6.0	—	—	BU30S05-1006WT	BU30S05-1506WT	BU30S05-2506WT		
	10	—	—	—	BU30S05-1510WT	BU30S05-2510WT	10	BU30S05-0110CC

* Guard cartridge holder required, part no. XPGCH-Q1 for 2.1 - 4.0 mmI.D. and XPCHSPW1 for 10 mmI.D.

※ See P.122 for preparative columns other than those listed above.

Ordering Information -Columns-

YMC-Pack TMS

Phase dimension	Column I.D. (mm)	Column length (mm)					Guard cartridges	
		50	75	100	150	250	I.D. (mm)	10 mm length
120 Å 3 µm	4.6	—	—	TM12S03-1046WT	TM12S03-1546WT	—	4.0	TM12S03-0104GC
120 Å 5 µm	2.0	—	—	—	TM12S05-1502WT	TM12S05-2502WT	2.1	TM12S05-01Q1GC
	4.6	—	TM12S05-L546WT	TM12S05-1046WT	TM12S05-1546WT	TM12S05-2546WT	4.0	TM12S05-0104GC
	6.0	—	—	TM12S05-1006WT	TM12S05-1506WT	TM12S05-2506WT		
	10	—	—	—	TM12S05-1510WT	TM12S05-2510WT	10	TM12S05-0110CC

YMC-Pack Ph

Phase dimension	Column I.D. (mm)	Column length (mm)					Guard cartridges	
		50	75	100	150	250	I.D. (mm)	10 mm length
120 Å 3 µm	2.0	PH12S03-0502WT	PH12S03-L502WT	PH12S03-1002WT	PH12S03-1502WT	—	2.1	PH12S03-01Q1GC
	3.0	PH12S03-0503WT	—	PH12S03-1003WT	PH12S03-1503WT	—	3.0	PH12S03-0103GC
	4.6	—	—	PH12S03-1046WT	PH12S03-1546WT	—	4.0	PH12S03-0104GC
120 Å 5 µm	2.0	—	—	—	PH12S05-1502WT	PH12S05-2502WT	2.1	PH12S05-01Q1GC
	4.6	—	PH12S05-L546WT	PH12S05-1046WT	PH12S05-1546WT	PH12S05-2546WT	4.0	PH12S05-0104GC
	6.0	—	—	PH12S05-1006WT	PH12S05-1506WT	PH12S05-2506WT		
	10	—	—	—	PH12S05-1510WT	PH12S05-2510WT	10	PH12S05-0110CC

YMC-Pack CN

Phase dimension	Column I.D. (mm)	Column length (mm)					Guard cartridges	
		50	75	100	150	250	I.D. (mm)	10 mm length
120 Å 3 µm	2.0	CN12S03-0502WT	CN12S03-L502WT	CN12S03-1002WT	CN12S03-1502WT	—	2.1	CN12S03-01Q1GC
	3.0	CN12S03-0503WT	—	CN12S03-1003WT	CN12S03-1503WT	—	3.0	CN12S03-0103GC
	4.6	—	—	CN12S03-1046WT	CN12S03-1546WT	—	4.0	CN12S03-0104GC
120 Å 5 µm	2.0	—	—	—	CN12S05-1502WT	CN12S05-2502WT	2.1	CN12S05-01Q1GC
	4.6	—	CN12S05-L546WT	CN12S05-1046WT	CN12S05-1546WT	CN12S05-2546WT	4.0	CN12S05-0104GC
	6.0	—	—	CN12S05-1006WT	CN12S05-1506WT	CN12S05-2506WT		
	10	—	—	—	CN12S05-1510WT	CN12S05-2510WT	10	CN12S05-0110CC
300 Å 5 µm	2.0	—	—	—	CN30S05-1502WT	CN30S05-2502WT	2.1	CN30S05-01Q1GC
	4.6	—	CN30S05-L546WT	CN30S05-1046WT	CN30S05-1546WT	CN30S05-2546WT	4.0	CN30S05-0104GC
	6.0	—	—	CN30S05-1006WT	CN30S05-1506WT	CN30S05-2506WT		

YMC-Pack PROTEIN-RP

Particle size	Column I.D. (mm)	Column length (mm)					Guard cartridges	
		50	75	100	150	250	I.D. (mm)	10 mm length
5 µm	2.0	—	—	—	PR99S05-1502WT	PR99S05-2502WT	2.1	PR99S05-01Q1GC
	4.6	—	—	—	PR99S05-1546WT	PR99S05-2546WT	4.0	PR99S05-0104GC
	10	—	—	—	—	PR99S05-2510WT	10	PR99S05-01Q1GC

YMCbasic

Phase dimension	Column I.D. (mm)	Column length (mm)					Guard cartridges	
		50	75	100	150	250	I.D. (mm)	10 mm length
200 Å 3 µm	2.0	BA99S03-0502WT	BA99S03-L502WT	BA99S03-1002WT	BA99S03-1502WT	—	2.1	BA99S03-01Q1GC
	3.0	BA99S03-0503WT	—	BA99S03-1003WT	BA99S03-1503WT	—	3.0	BA99S03-0103GC
	4.6	BA99S03-0546WT	—	BA99S03-1046WT	BA99S03-1546WT	—	4.0	BA99S03-0104GC
200 Å 5 µm	2.0	—	—	—	BA99S05-1502WT	—	2.1	BA99S05-01Q1GC
	3.0	—	—	—	BA99S05-1503WT	—	3.0	BA99S05-0103GC
	4.6	BA99S05-0546WT	—	BA99S05-1046WT	BA99S05-1546WT	BA99S05-2546WT	4.0	BA99S05-0104GC
	6.0	—	—	—	BA99S05-1506WT	BA99S05-2506WT		

YMC Carotenoid

Particle size	Column I.D. (mm)	Column length (mm)					Guard cartridges	
		50	75	100	150	250	I.D. (mm)	10 mm length
3 µm	4.6	—	—	CT99S03-1046WT	CT99S03-1546WT	-	4.0	CT99S03-0104GC
5 µm	4.6	—	—	—	CT99S05-1546WT	CT99S05-2546WT	4.0	CT99S05-0104GC

* Guard cartridge holder required, part no. XPGCH-Q1 for 2.1 - 4.0 mmI.D. and XPCHSPW1 for 10 mmI.D.

※ See P.122, 123 for preparative columns other than those listed above.