# YMC-TriArt

Versatile hybrid silica based (U)HPLC columns

YMC EUROPE GMBH
The Selectivity Company

## Transfer

Scalable particles:
EASY
UHPLC ↔ HPLC

## Flexible

YMC-TriArt:
pH 1-12
Temperatures
up to 70°C

## Universal

YMC-TriArt
for acidic, basic and
neutral analytes

www.ymc.de

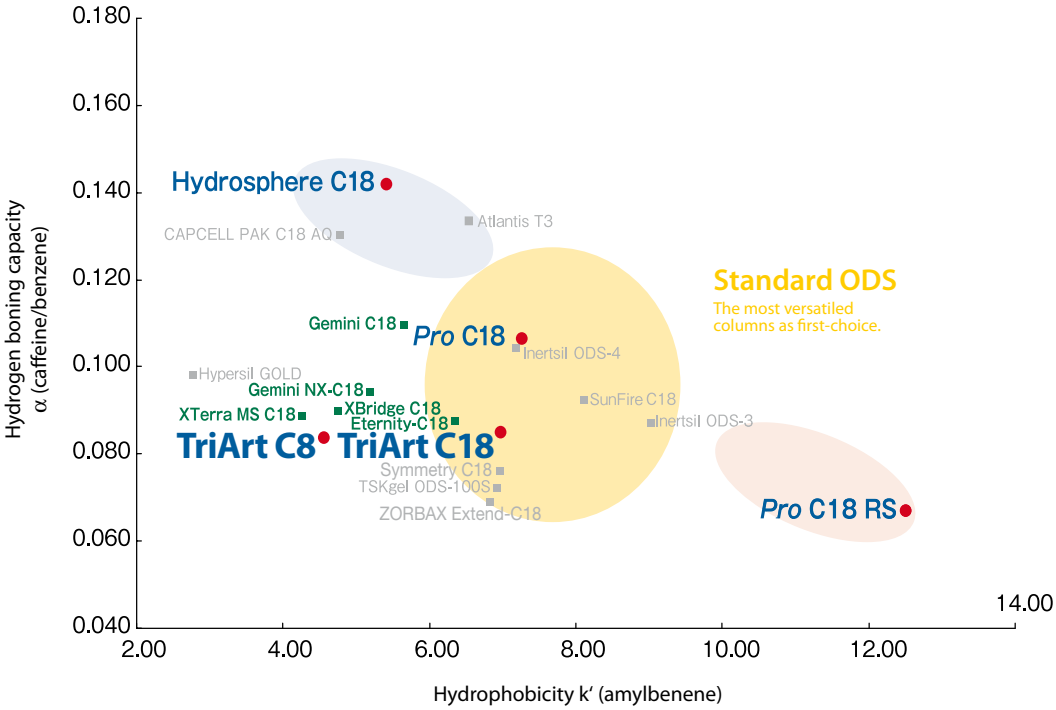
2

# YMC-TriArt




Schöttmannshof 19 · D-46539 Dinslaken · Phone +49 (0) 20 64 427-0 · Telefax +49 (0) 20 64 427-222
E-Mail: info@ymc.de · www.ymc.de

## First choice column for method development




Conventional hybrid silica-based ODS columns tend to be less hydrophobic than silica-based columns. YMC-TriArt C18 has a higher carbon load, giving it a hydrophobicity comparable to that of standard ODS columns, thereby making it a "versatile first-choice" column for method development.

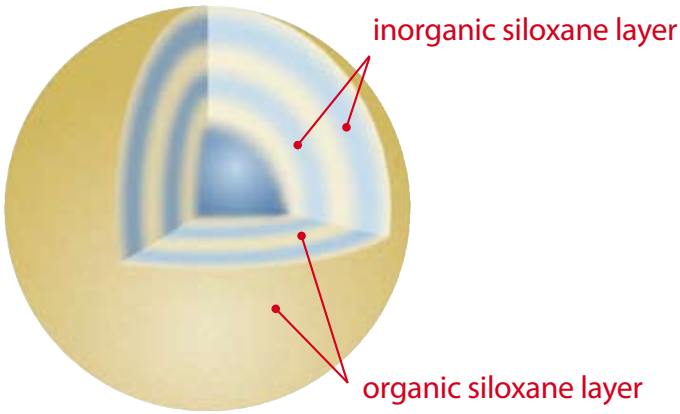
Chromatographers always seek to push the limits of HPLC columns to greater extremes to allow them to perform day-to-day with ever-changing pH, buffers and temperature ranges. The column for the laboratory of today must be suitable for harsh pH conditions in combination with high temperature ranges without sacrificing selectivity. In addition narrow, symmetrical peak shapes are necessary in order to cope with rapid analysis of demanding samples. This has required manufacturers to seek more innovative ways to produce suitable stationary phases.

In order to meet these goals, YMC has developed a new particle technology. This is based on a multi-layered particle produced via a tightly controlled granulation technology which has been adapted from micro-reactor technology. The revolutionary production technique provides a multi-layer silica-organic hybrid stationary phase, which provides an outstandingly narrow pore size and particle size distribution. This in turn, results in low back pressures and high loadability.

## Particle technology

YMC-TriArt is a multi-layered material prepared using tightly controlled particle formation technology which has been adapted from micro-reactor technology. This recently developed production process results in exceptionally narrow particle and pore size distributions.
With YMC-TriArt, challenging pH and high temperature conditions are no longer a limitation to the day-to-day work in laboratories. Most importantly, due to its unique particle composition, a balanced hydrophobicity and silanol activity are achieved which makes YMC-TriArt a "First Choice" column in method development.

### YMC-TriArt hybrid structure



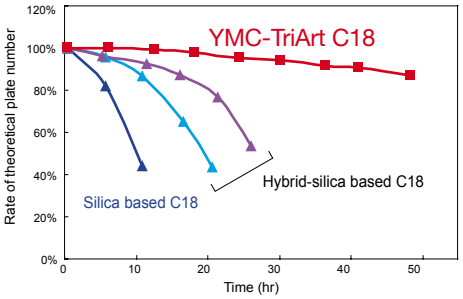

## Specification

| | YMC-TriArt C18 | YMC-TriArt C8 |
|---|---|---|
| **Base** | organic/inorganic silica | organic/inorganic silica |
| **Stationary phase** | C18 (as USP L1) | C8 (as USP L7) |
| **Particle size** | 1.9, 3 and 5 µm | 1.9, 3 and 5 µm |
| **Pore size** | 12 nm | 12 nm |
| **Carbon load** | 16% (20% in total) | 7% (11% in total) |
| **Bonding** | polymeric type | polymeric type |
| **End-capping** | multi-stage hybrid groups | multi-stage hybrid groups |
| **pH range** | 1 ~ 12 | 1 ~ 12 |
| **Temperature range** | pH 1-7: 70 °C, pH 7-12: 50 °C | pH 1-7: 70 °C, pH 7-12: 50 °C |

Schöttmannshof 19 · D-46539 Dinslaken · Phone +49 (0) 20 64 427-0 · Telefax +49 (0) 20 64 427-222
E-Mail: info@ymc.de · www.ymc.de

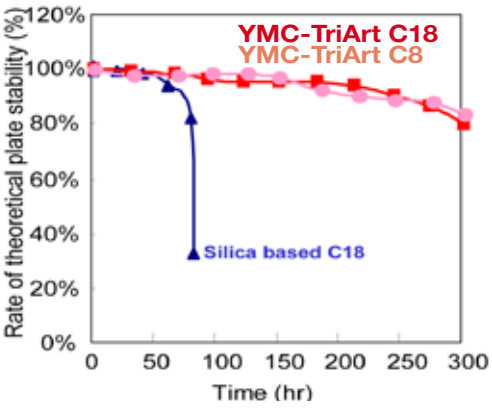
# Versatile wide pH stability

## Phosphate buffer (pH 11.5, 40 °C)




| | |
|---|---|
| Column: | 5 µm, 150 x 4.6 mm ID |
| Part-No.: | TA12S051546PT |
| Eluent: | 50 mM $K_2HPO_4$-$K_3PO_4$ (pH 11.5) / methanol (90/10) |
| Flow rate: | 1.0 ml/min |
| Temperature: | 40 °C |
| Sample: | benzyl alcohol |

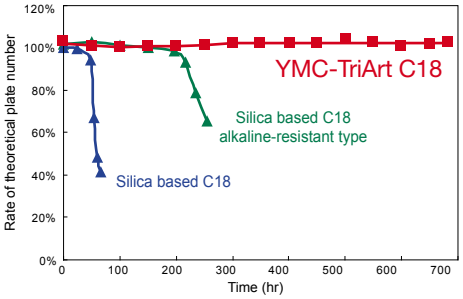
## Triethylamine (pH 11.5, 40 °C)




| | |
|---|---|
| Column: | 5 µm, 150 x 4.6 mm ID |
| Part-No.: | TA12S051546PT |
| Eluent: | 50 mM triethylamine (pH 11.5) / methanol (90/10) |
| Flow rate: | 1.0 ml/min |
| Sample: | benzyl alcohol |

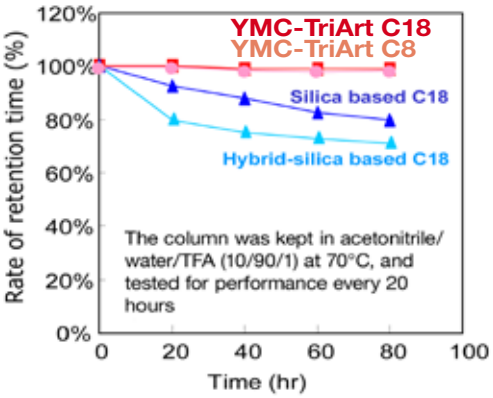
# Durability at high temperature

## pH 6.9, 70 °C




| | |
|---|---|
| Column: | 5 µm, 50 x 2.0 mm ID |
| Part-No.: | TA12S050502PT |
| Eluent: | 20 mM $KH_2PO_4$-$K_2HPO_4$ (pH 6.9) / acetonitrile (90/10) |
| Flow rate: | 0.2 ml/min |
| Temperature: | 70 °C |
| Sample: | phenol |

## pH 1, 70 °C




| | |
|---|---|
| Column: | 5 µm, 50 x 2.0 mm ID |
| Part-No.: | TA12S050502PT |
| Eluent: | acetonitrile / water (60/40) |
| Flow rate: | 0.2 ml/min |
| Temperature: | 70 °C |
| Sample: | butyl benzoate |

YMC-TriArt C18 and C8 show great chemical stability due to the newly developed hybrid-silica. Even under high pH or high temperature conditions, the lifetime of YMC-TriArt C18 and C8 is more than 10x greater than conventional reversed phase columns.

Schöttmannshof 19 · D-46539 Dinslaken · Phone +49 (0) 20 64 427-0 · Telefax +49 (0) 20 64 427-222
E-Mail: info@ymc.de · www.ymc.de

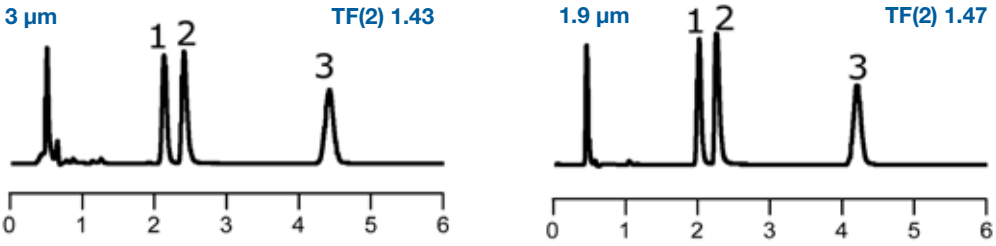
Transfer HPLC ↕ UHPLC

6

## Secure your method transfer!

Differences in selectivity, retention time, and also peak shapes between different particle sizes of commercially available C18 phases in the same brand (or an alternative as recommended by its manufacture) have been observed.

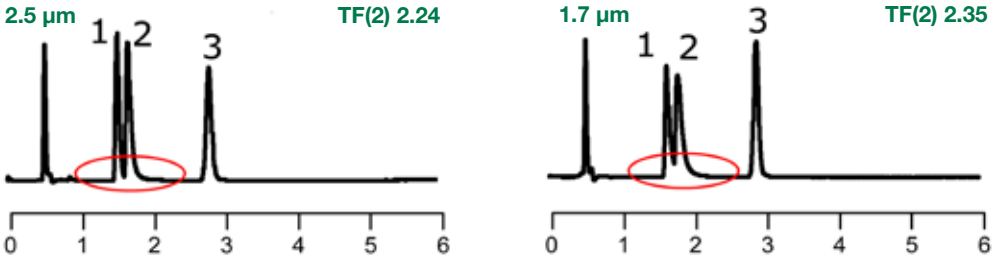
### YMC-TriArt C18



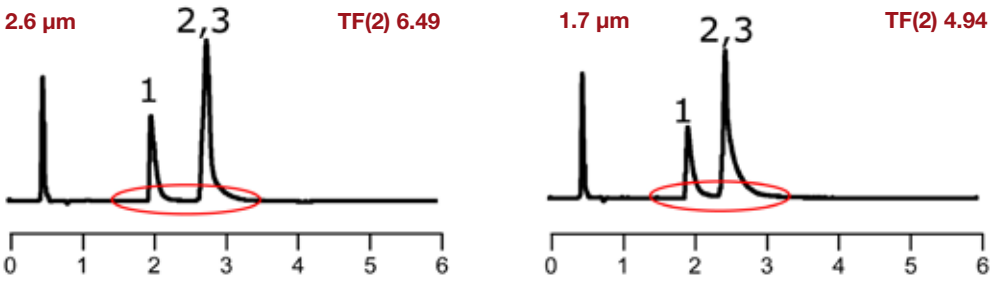

YMC has adressed this issue of method transfer. YMC-TriArt columns show identical selectivity and excellent peak shapes for basic compounds for all 3.0 µm to 1.9 µm particle sizes. It allows predictable scale up from UHPLC to conventional HPLC and even to semi-preparative LC, and vice versa.

### Case Studies*

### X-Bridge BEH C18 and Acquity UPLC BEH C18




### Kinetex™ C18




Kinetex™ C18 columns show significant peak tailing and have limited scalability due to lack of larger particle sizes.

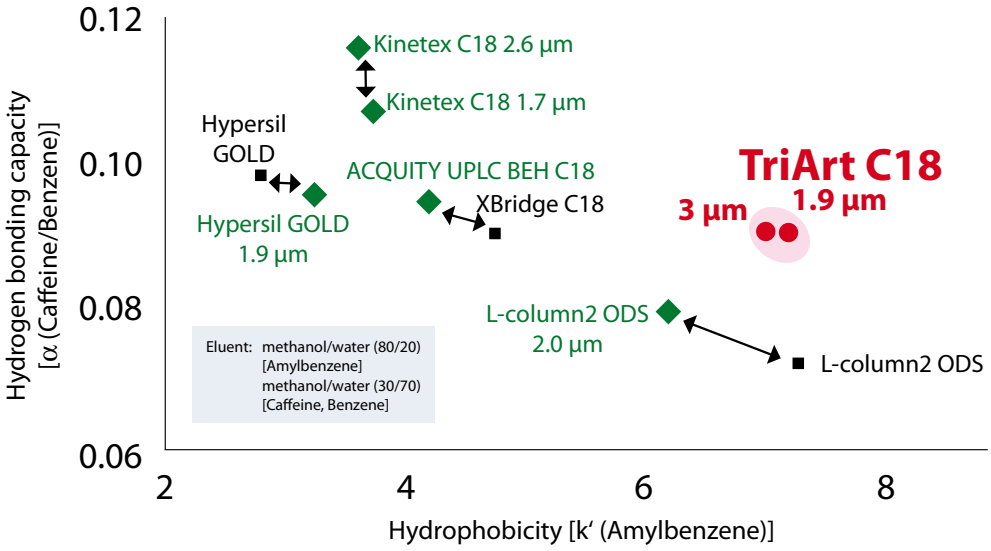
| | |
|---|---|
| Column: | 50 x 2.0 mm ID or 2.1 mm ID |
| Eluent: | 20 mM $KH_2PO_4$-$K_2HPO_4$ (pH 6.9) / acetonitrile (65/35) |
| Temperature: | 40 °C |
| Flow rate: | 0.2 ml/min |
| Detection: | UV at 235 nm |

1. Chlorpheniramine (basic)
2. Dextromethorphan (basic)
3. Propyl paraben (internal standard)

*There observations might not be representative for all applications but have been reported in some cases.

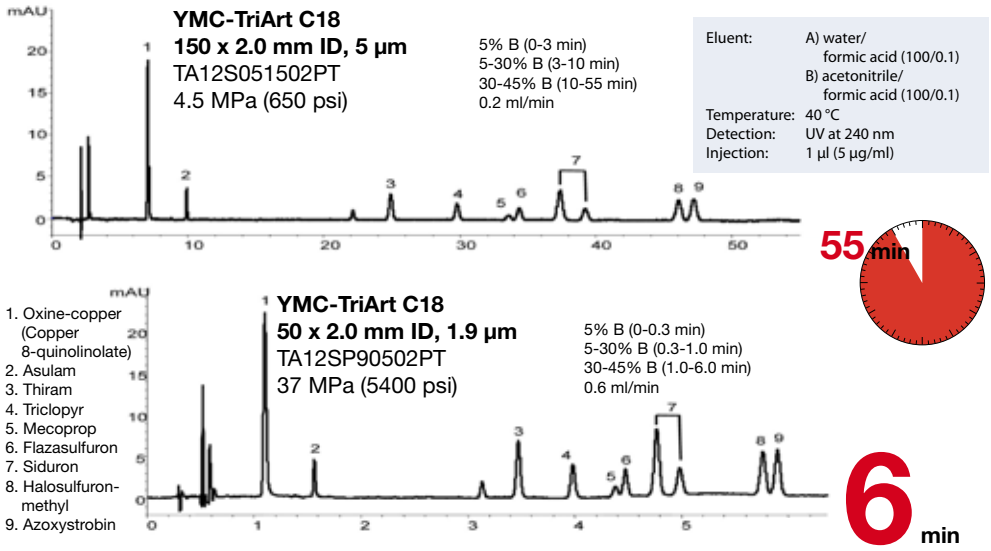
Schöttmannshof 19 · D-46539 Dinslaken · Phone +49 (0) 20 64 427-0 · Telefax +49 (0) 20 64 427-222
E-Mail: info@ymc.de · www.ymc.de

## Evaluation of method transfer performance!



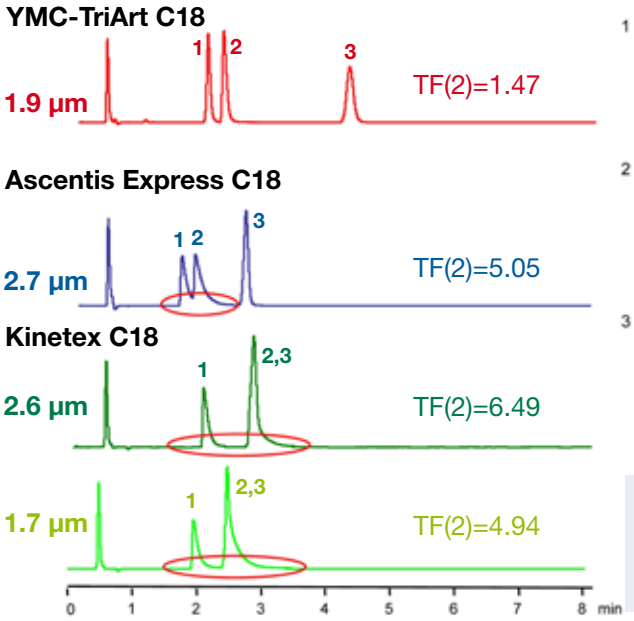

With the introduction of UHPLC, sub-2-µm particles became neccessary. Therefore smaller particles have been added to existing column lines. Consequently, sub-2-µm particles may exhibit differences in chromatographic performance.
By introducing YMC-TriArt, YMC provides matching chromatographic behaviour for **all** particles sizes!

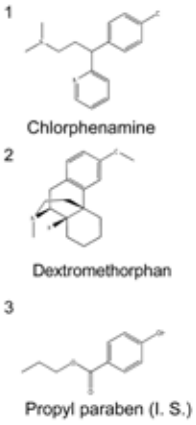
## Method transfer between HPLC ↔ UHPLC




Schöttmannshof 19 · D-46539 Dinslaken · Phone +49 (0) 20 64 427-0 · Telefax +49 (0) 20 64 427-222
E-Mail: info@ymc.de · www.ymc.de

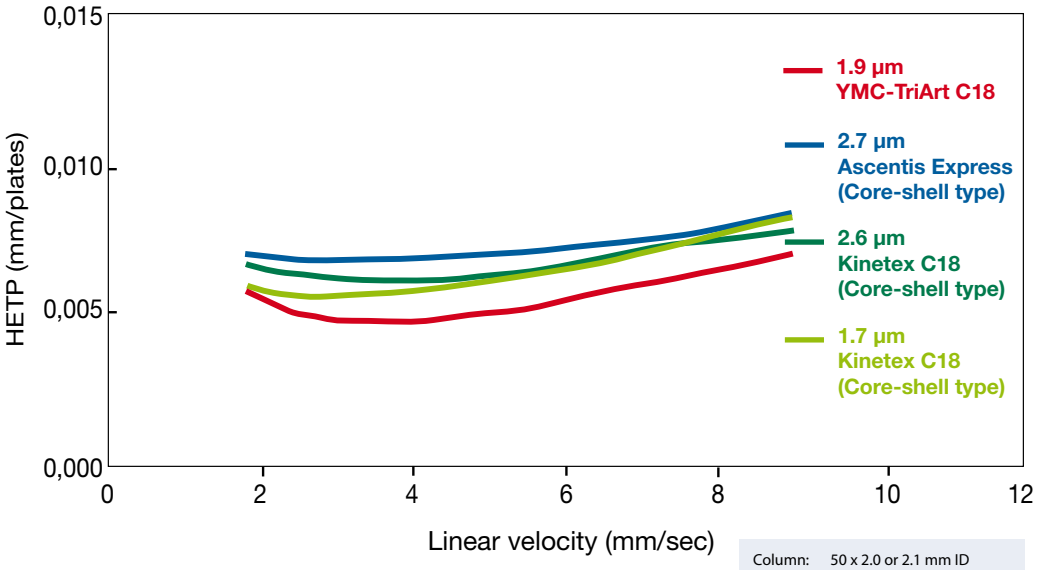
## Higher resolution and good loadability




| | |
|---|---|
| Column: | 50 x 2.0 or 2.1 mm ID |
| Eluent: | 20 mM $KH_2PO_4$-$K_2HPO_4$ (pH 6.9)/ acetonitrile (65/35) |
| Flow rate: | 0.2 ml/min |
| Detection: | UV at 235 nm |
| Temperature: | 40 °C |

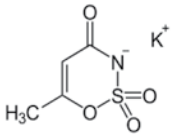
## Lower HETP means higher resolution!



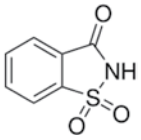

| | |
|---|---|
| Column: | 50 x 2.0 or 2.1 mm ID |
| Eluent: | acetonitrile / water (60/40) |
| Detection: | UV at 254 nm |
| Sample: | Butylbenzoate |

Schöttmannshof 19 · D-46539 Dinslaken · Phone +49 (0) 20 64 427-0 · Telefax +49 (0) 20 64 427-222
E-Mail: info@ymc.de · www.ymc.de

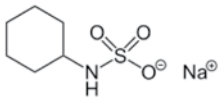
# Determination of Artificial Sweeteners with LC-MS/MS



Acesulfam-K

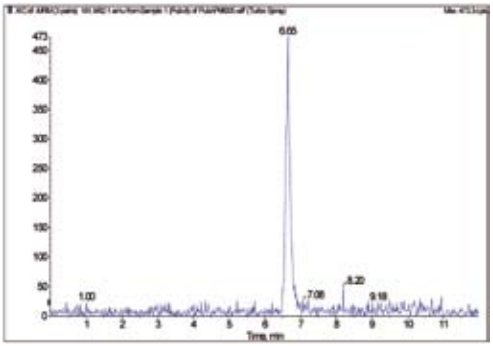


Saccharin

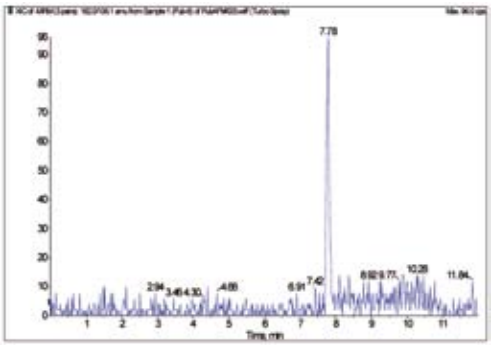


Cyclamat-Na

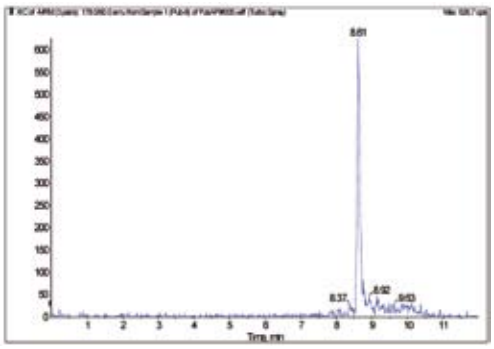
➔ Non biological markers of wastewater entries in ground and surface water



Extracted Ion Chromatogram (XIC) of Acesulfam-K, 0.1 µg/L



Extracted Ion Chromatogram (XIC) of Saccharin, 0.1 µg/L

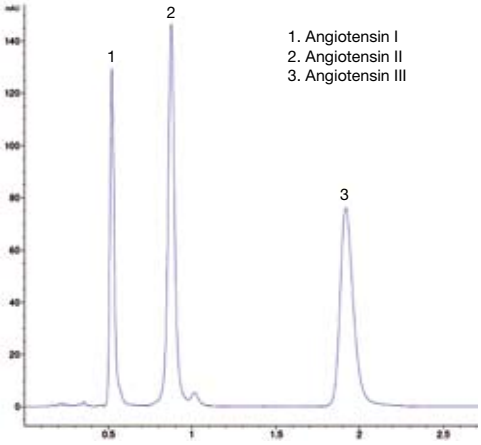


Extracted Ion Chromatogram (XIC) of Cyclamat-Na, 0.1 µg/L

| | | | | | |
|---|---|---|---|---|---|
| Column: | YMC-TriArt C18, 12 nm, 1.9 µm, 100 x 3.0 mm ID | | | | |
| Part-No.: | TA12SP91003PT | | | | |
| LC-System: | Agilent 1100 HPLC system and CTC Analytics HTC-Pal Autosampler | | | | |
| MS/MS System: | Applied Biosystems MDS Sciex API 4000, ESI negative | | | | |
| Temperature: | 35°C | | | | |
| Flow: | 0.3 ml/min | | | | |
| Injection: | 40 µL, direct injection | | | | |
| Eluent: | A: $H_2O$ (containing 10 mmol $NH_4$ formate) | | | | |
| | B: MeOH (containing 10 mmol $NH_4$ formate) | | | | |
| Gradient: | Time | 0 | 6.0 | 6.1 | 12.0 |
| | % B | 2 | 75 | 2 | 2 |

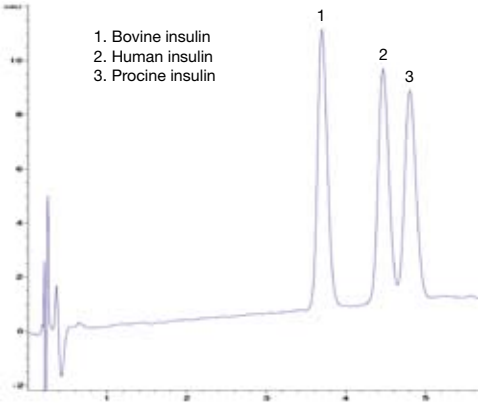
by courtesy of: Thomas Class, Sandro Jooß
PTRL Europe, Helmoholtzstraße 22, Science Park I, D-89081 Ulm

## Angiotensin I, II and III



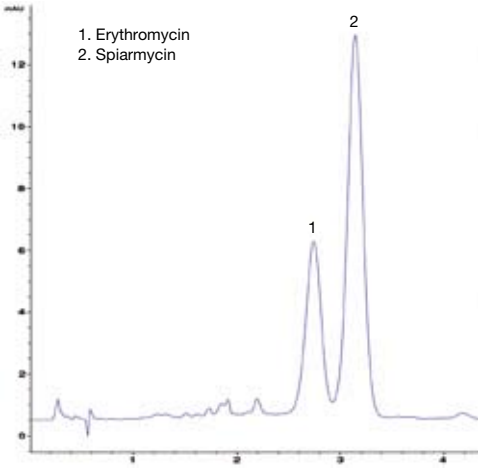

| | |
|---|---|
| Column: | TA12SP90502PT |
| Dimension: | 50 x 2.0 mm ID |
| Eluent: | 20 mM $KH_2PO_4$ + $K_2HPO_4$ (pH 7.9) / acetonitrile (22/78) |
| Flow rate: | 0.7 ml/min |
| Detection: | UV at 220 nm |
| Pressure: | 720 bar |
| Injection: | 0.5 µl |
| Temperature: | 40 °C |

## Insulin



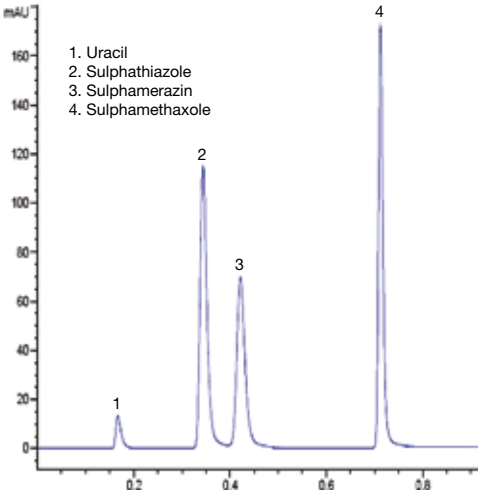

| | |
|---|---|
| Column: | TA12SP90502PT |
| Dimension: | 50 x 2.0 mm ID |
| Eluent: | A) $H_2O$ + 0.1% TFA<br>B) acetonitrile + 0.1% TFA |
| Gradient: | 30% B (0 min); 30-32% B (0-5 min); 32% B (55 min) |
| Flow rate: | 0.6 ml/min |
| Detection: | UV at 220 nm |
| Pressure: | 611 bar |
| Injection: | 0.5 µl |
| Temperature: | 30 °C |

## Macrolide antibiotics




| | |
|---|---|
| Column: | TA12SP90502WT |
| Dimension: | 50 x 2.0 mm ID |
| Eluent: | A) 20 mM $K_2HPO_4$ + 20 mM $KH_2PO_4$ (pH 7.9)<br>B) acetonitrile |
| Gradient: | 60% B (0.5 min); 60-70% B (0.5-1.5 min); 70% B (3.5 min) |
| Flow rate: | 0.45 ml/min |
| Detection: | UV at 210 nm |
| Pressure: | 520 bar |
| Injection: | 1 µl |
| Temperature: | 50 °C |

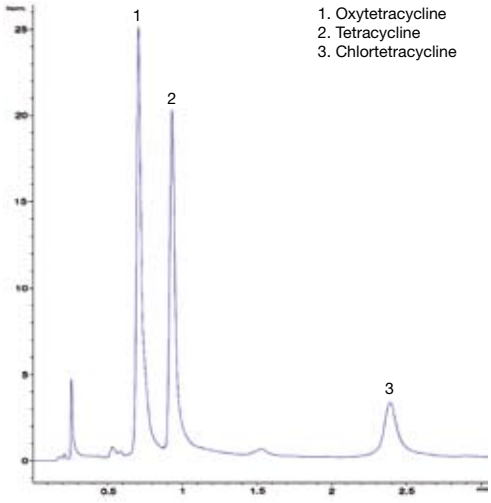
## Sulpha drugs




| | |
|---|---|
| Column: | TA12SP90502WT |
| Dimension: | 50 x 2.0 mm ID |
| Eluent: | $H_2O$ + formic acid (pH 2.5) / acetonitrile (75/25) |
| Flow rate: | 0.75 ml/min |
| Detection: | UV at 280 nm |
| Pressure: | 740 bar |
| Injection: | 0.5 µl |
| Temperature: | 50 °C |

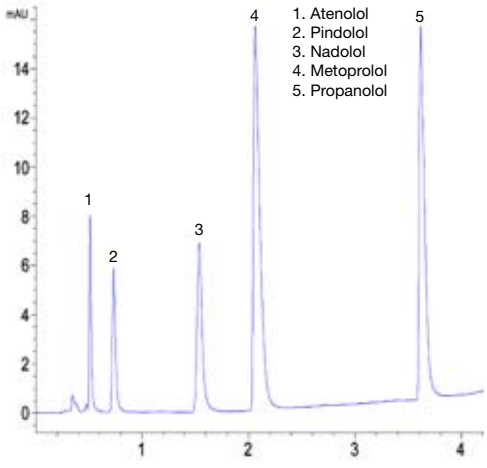
Schöttmannshof 19 · D-46539 Dinslaken · Phone +49 (0) 20 64 427-0 · Telefax +49 (0) 20 64 427-222
E-Mail: info@ymc.de · www.ymc.de

## Tetracycline antibiotics




| | |
|---|---|
| Column: | TA12SP90502WT |
| Dimension: | 50 x 2.0 mm ID |
| Eluent: | 5 mM $NH_4CH_3COOH$ / acetonitrile (87/13) |
| Flow rate: | 0.65 ml/min |
| Detection: | UV at 280 nm |
| Pressure: | 662 bar |
| Injection: | 1 µl |
| Temperature: | 40 °C |

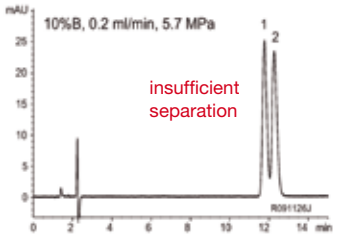
## Betablockers



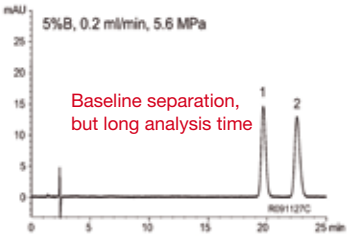

| | |
|---|---|
| Column: | TA12SP90502PT |
| Dimension: | 50 x 2.0 mm ID |
| Eluent: | A) 20 mM $NH_4CH_3COOH$ + ammonia (pH 9.0) |
| | B) acetonitrile |
| Gradient: | 25% B (1.0 min); 75% B (1-6 min) |
| Flow rate: | 0.35 ml/min |
| Detection: | UV at 254 nm |
| Pressure: | 450 bar |
| Injection: | 1 µl |
| Temperature: | 40 °C |

## Fast LC for conventional HPLC

YMC-TriArt C18, 5 µm, 150 x 2.0 mm ID

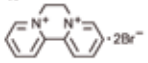



optimisation

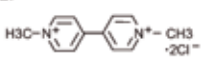



Down scaling

1. Diquat



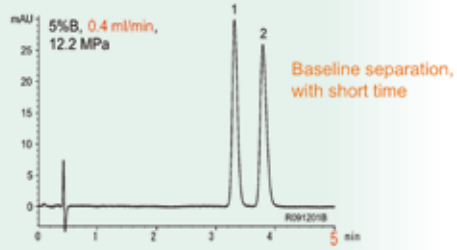
2. Paraquat



| | |
|---|---|
| Eluent: | A) water / HFBA* (100/0.1) |
| | B) acetonitrile / HFBA* (100/0.1) |
| Temperature: | 37 °C |
| Detection: | UV at 290 nm |
| Injection: | 1 µl (0.1 mg/ml) |

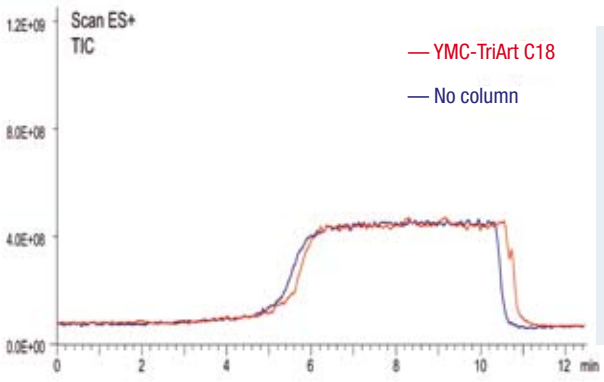
*heptafluorobutyric acid

YMC-TriArt C18, 3 µm, 50 x 2.0 mm ID




Schöttmannshof 19 · D-46539 Dinslaken · Phone +49 (0) 20 64 427-0 · Telefax +49 (0) 20 64 427-222
E-Mail: info@ymc.de · www.ymc.de

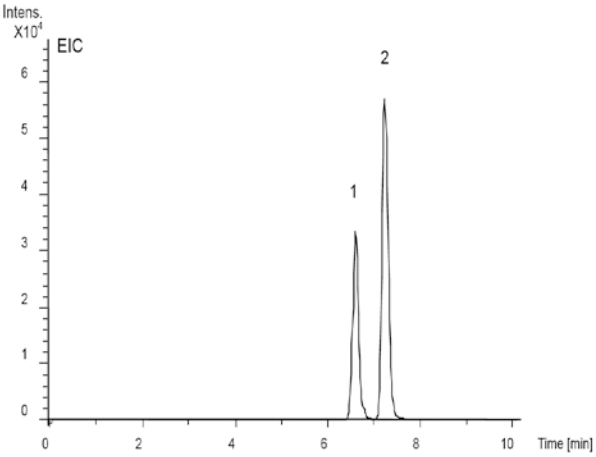
## LC/MS compatibility




| | |
|---|---|
| Column: | 5 µm, 50 x 2.0 mm ID |
| Part-No.: | TA12S050502PT |
| Eluent: | A) water / formic acid (100/0.1)<br>B) acetonitrile / formic acid (100/0.1)<br>5% B (0-1 min), 5-100% B (1-5 min), 100% B (5-10 min), 100-5% B (10-10.1 min), 5% B (10.1-12.5 min) |
| Flow rate: | 0.4 ml/min |
| Temperature: | 40 °C |
| Detection: | ESI positive, TIC (Mass Range: 50-1000) |

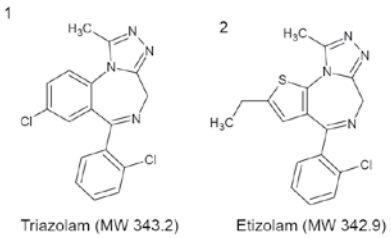
Column bleeding, caused by the fragments of stationary phase, is the main reason for background noise and restrictions on detection limits. No bleed is observed in the test of total ion current (TIC) measured by LC/MS with blank or with YMC-TriArt C18. So in terms of the signal/noise ratio (S/N ratio), YMC-TriArt C18 can be expect to not only reduce the background noise but to also increase the sensitivity of the analysis.

## LC/MS analysis of benzodiazepine derivates



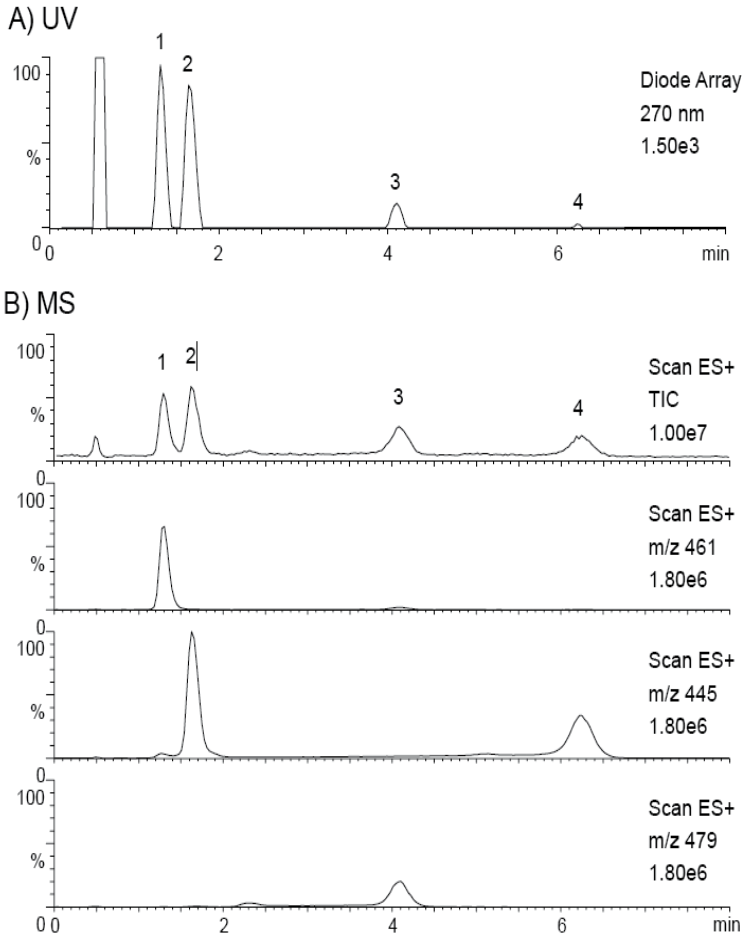

Peak 1: 100ng_ml_RB4_01_2291.d: EIC 343.051±0.01+All MS
Peak 2: 100ng_ml_RB4_01_2291.d: EIC 343.078±0.01+All MS

Courtesy of J. Watanabe, Bruker Daltonics K. K.

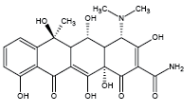



| | |
|---|---|
| Column: | YMC-TriArt C18 (5 µm, 12 nm) 50 x 2.0 mm ID |
| Part-No.: | TA12S050502PT |
| Eluent: | A) 10 mM formic acid<br>B) acetonitrile |
| Gradient: | 25-50% B (0-10 min) |
| Flow rate: | 0.2 ml/min |
| Temperature: | 40 °C |
| Detection: | Bruker Daltonics micrOTOF, ESI, positive mode |
| Injection: | 5 µl (100 ng/ml) |

# LC/MS analysis of tetracycline antibiotics

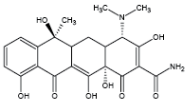



1



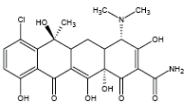
Oxytetracycline
(MW 460.4)

2



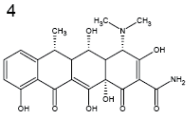
Tetracycline
(MW 444.4)

3

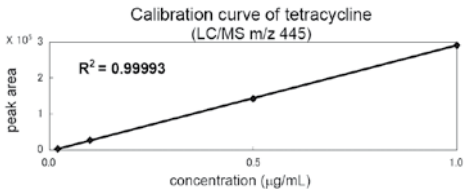


Chlortetracycline
(MW 478.8)

4



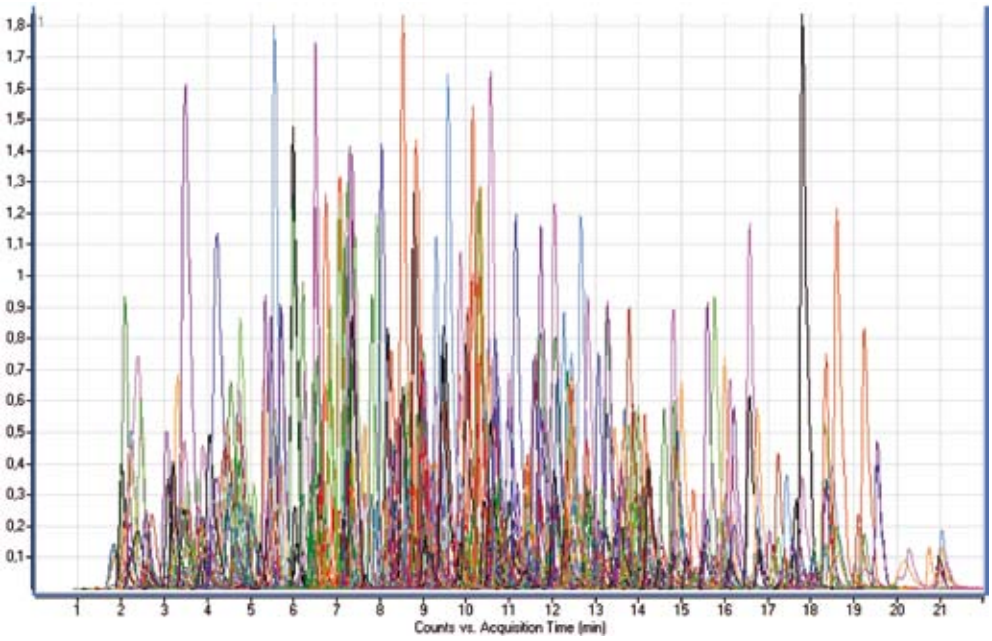
Doxycycline
(MW 444.4)




| | |
|---|---|
| Column: | YMC-TriArt C18 (5 µm, 12 nm) 50 x 2.0 mm ID |
| Part-No.: | TA12S050502PT |
| Eluent: | acetonitrile / water / formic acid (15/85/0.1) |
| Flow rate: | 0.4 ml/min |
| Temperature: | 40 °C |
| Detection: | A) UV at 270 nm<br>B) ESI positive-mode |
| Injection: | 10 µl (1 µg/ml) |

Schöttmannshof 19 · D-46539 Dinslaken · Phone +49 (0) 20 64 427-0 · Telefax +49 (0) 20 64 427-222
E-Mail: info@ymc.de · www.ymc.de

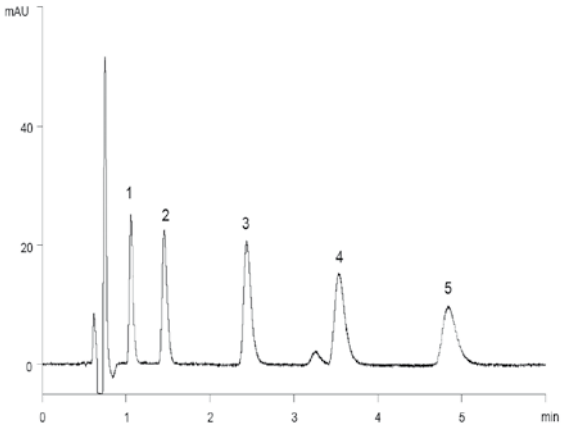
# Analysis of 360 pesticides in a single run




| | | | |
|---|---|---|---|
| Column: | YMC-TriArt C18 (3 µm, 100 x 2.0 mm ID) | Injection: | 5 µl |
| Part-No.: | TA12S031002PT | Gradient: | 0 min: 30% B, 0.1 min: 50% B, 18 min: 100% B, 21 min: 100% B, 21.01 min: 30% B, 29 min: 30% B |
| Eluent: | A) 5 mM ammonium formate / water<br>B) 5 mM ammonium formate / methanol | Total run time: | 30 min |
| Flow rate: | 0.25 ml/min | Detection: | |
| Temperature: | 45 °C | Sample: | 100 ng/ml pesticide mix in acetonitrile |

by courtesy of: József László
WIREC, WESSLING International Research and Educational Centre Nonprofit Co. (Hungary)

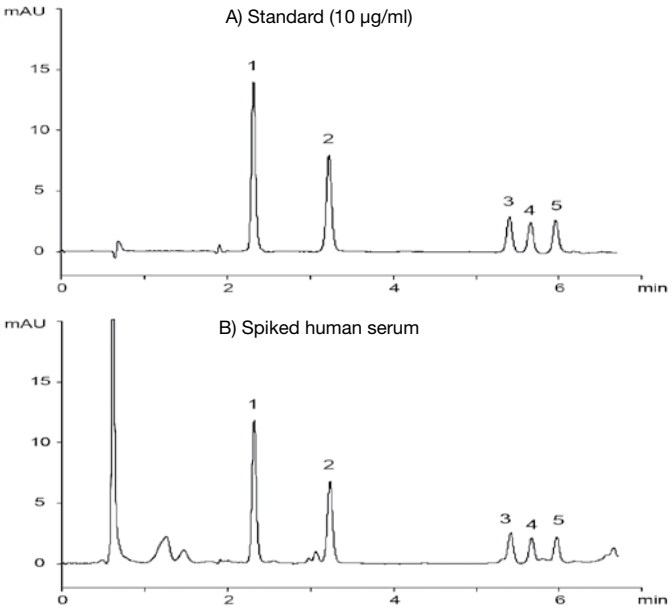
## Separation of alkaloids




1. Scopolamine
2. Atropine
3. Cinchonine
4. Quinine
5. Dihydroquinine

| | |
|---|---|
| Column: | YMC-TriArt C18 (5 µm, 12 nm) 50 x 2.0 mm ID |
| Part-No.: | TA12S050502PT |
| Eluent: | 20 mM $CH_3COOH$-$CH_3COONH_4$ (pH 4.9) / acetonitrile (80/20) |
| Flow rate: | 0.2 ml/min |
| Temperature: | 40 °C |
| Detection: | UV at 220 nm |
| Injection: | 1 µl (0.02-0.1 mg/ml) |

## Barbiturates in human serum



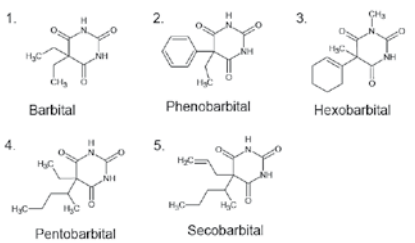

**Solid-phase extraction method**
YMC Dispo SPE C18 100 mg/1ml

**Condition**
2 ml methanol
2 ml water

**Load**
500 µl spiked human serum solution (each 10 µg)

**Elute**
500 µl methanol/water (85/15)

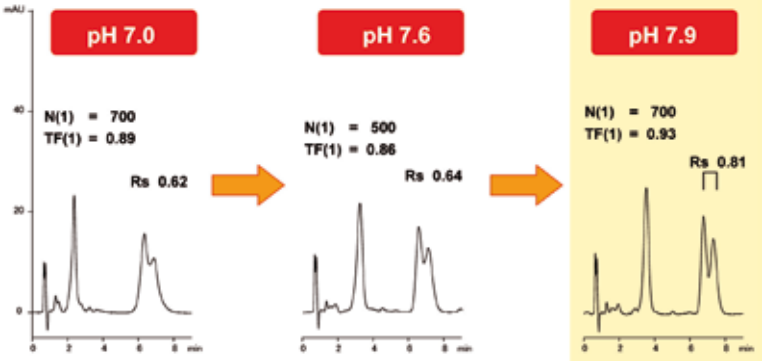
**Dilute**
500 µl 20 mM ammonium formate buffer (pH 9.5)

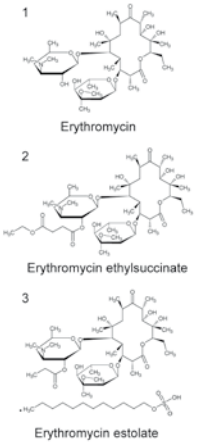



| | |
|---|---|
| Column: | YMC-TriArt C18 (5 µm, 12 nm) 50 x 2.0 mm ID |
| Part-No.: | TA12S050502PT |
| Eluent: | A) 20 mM $HCOONH_4$-$NH_3$ (pH 9.5) B) methanol |
| Gradient: | 0-90% B (0-7 min) |
| Flow rate: | 0.2 ml/min |
| Temperature: | 25 °C |
| Detection: | UV at 240 nm |
| Injection: | 1 µl |

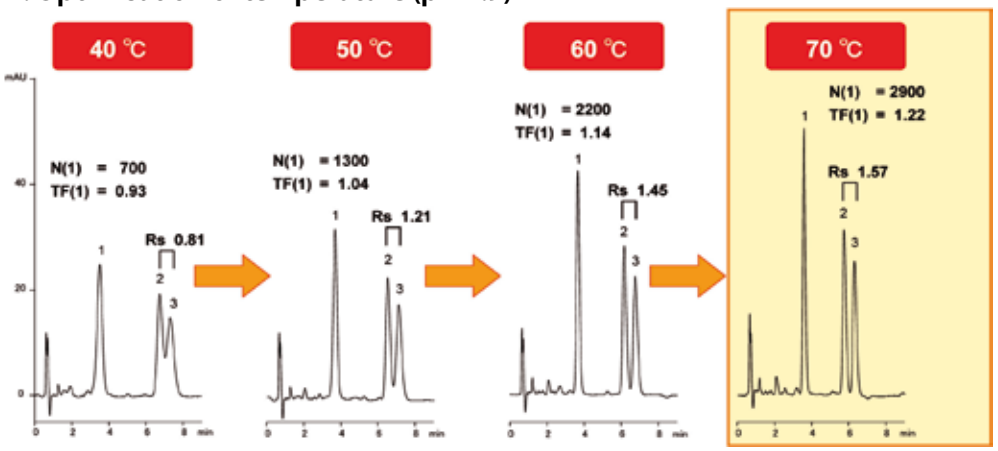
# Erythromycin at elevated pH and temperature

## 1. Optimisation of pH

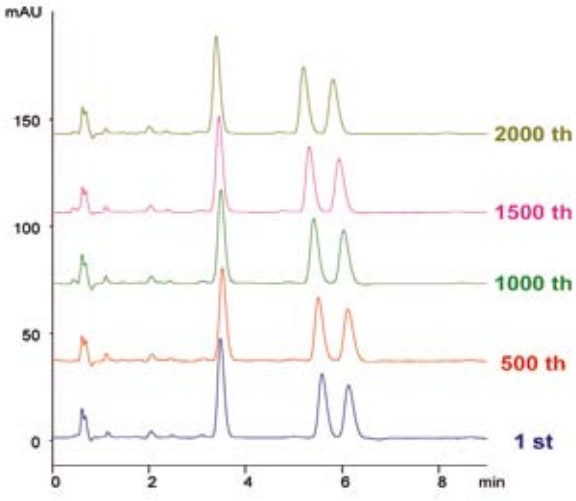



## 2. Optimisation of temperature (pH 7.9)



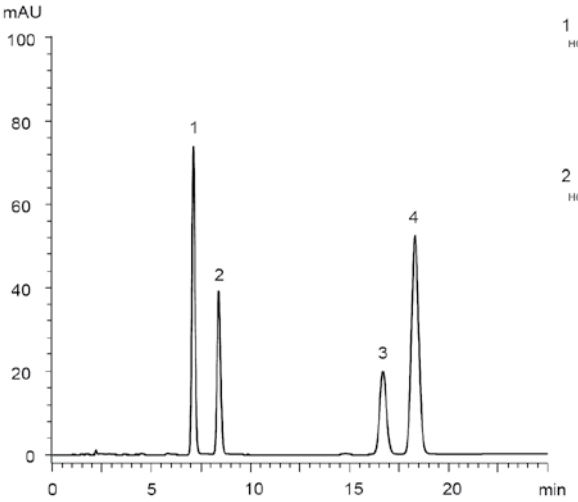

## 3. Stability test: pH 7.9, 70 °C




Number of injections

| | |
|---|---|
| Column: | YMC-TriArt C18 (3 µm, 12 nm) |
| Dimension: | 50 x 2.0 mm ID |
| Part-No.: | TA12S030502PT |
| Eluent: | 20 mM $KH_2PO_4$ -$K_2HPO_4$ / acetonitrile / methanol (40/45/15) |
| Flow rate: | 0.2 ml/min |
| Detection: | UV at 210 nm |

## Separation of flavonoids




1 Daidzein

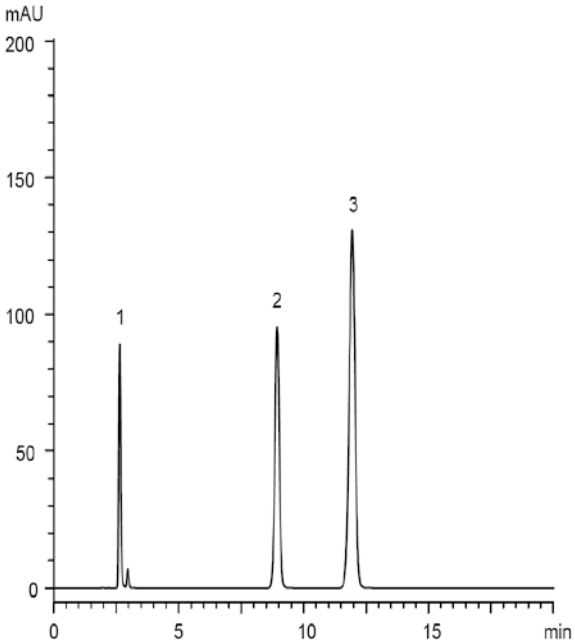
2 Luteolin

3 Kaempferol

4 Baicalein

| | |
|---|---|
| Column: | YMC-TriArt C18 (5 µm, 12 nm) |
| Dimension: | 150 x 3.0 mm ID |
| Eluent: | acetonitrile / 10 mM $H_3PO_4$ (30/70) |
| Flow rate: | 0.425 ml/min |
| Temperature: | 37 °C |
| Detection: | UV at 280 nm |
| Injection: | 2 µl (50 µg/ml) |

## Separation of aromatic carboxylic acids




1 Salicylic acid

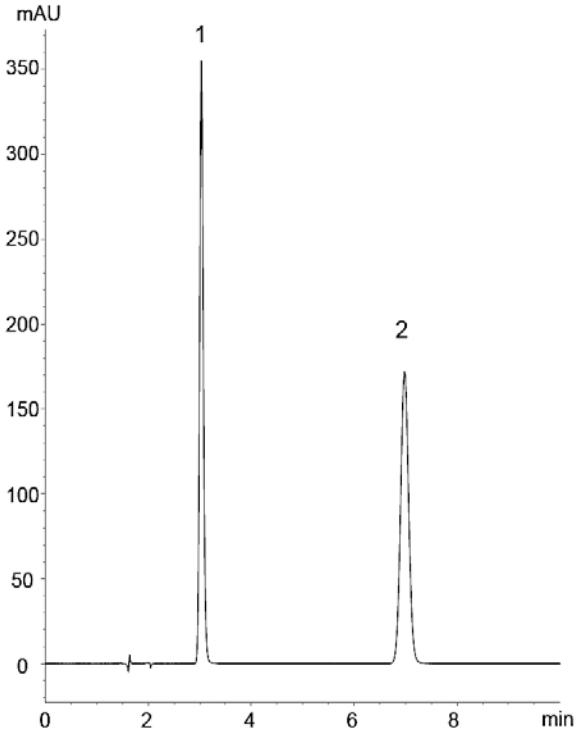
2 Methyl *p*-hydroxybenzoate (I.S.)

3 *trans*-Cinnamic acid

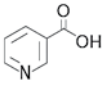
| | |
|---|---|
| Column: | YMC-TriArt C18 (5 µm, 12 nm) |
| Dimension: | 150 x 3.0 mm ID |
| Part-No.: | TA12S051503PT |
| Eluent: | 10 mM $CH_3COOH$-$CH_3COONH_4$ (pH 4.2) / acetonitrile (75/25) |
| Flow rate: | 0.425 ml/min |
| Temperature: | 40 °C |
| Detection: | UV at 254 nm |
| Injection: | 4 µl (0.02 ~ 0.3 mg/ml) |

Schöttmannshof 19 · D-46539 Dinslaken · Phone +49 (0) 20 64 427-0 · Telefax +49 (0) 20 64 427-222
E-Mail: info@ymc.de · www.ymc.de

# Aciclovir syrup and injection

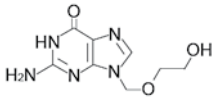



1.



Nicotinic acid

2.

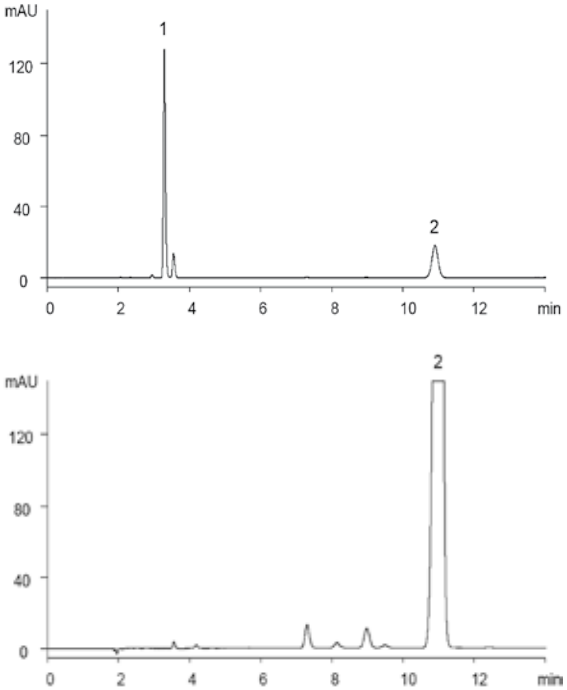


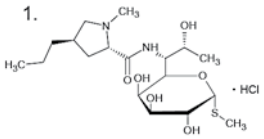
Aciclovir

| | |
|---|---|
| Column: | YMC-TriArt C18 (5 µm, 12 nm) 150 x 4.6 mm ID |
| Part-No.: | TA12S051546PT |
| Eluent: | phosphate buffer* / methanol (95/5) *Dissolve 1.45 g of $H_3PO_4$ and 25 ml of 1 mol/l $CH_3COOH$ in water to make 900 ml → adjust pH 2.5 by 1 mol/l NaOH → add water to make 1000 ml |
| Flow rate: | 1.0 ml/min |
| Temperature: | 25 °C |
| Detection: | UV at 254 nm |
| Injection: | 20 µl (0.05 mg/ml, 0.032 mg/ml) |

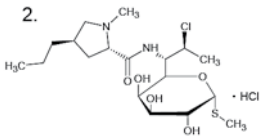
Schöttmannshof 19 · D-46539 Dinslaken · Phone +49 (0) 20 64 427-0 · Telefax +49 (0) 20 64 427-222
E-Mail: info@ymc.de · www.ymc.de

## Clindamycin hydrochloride



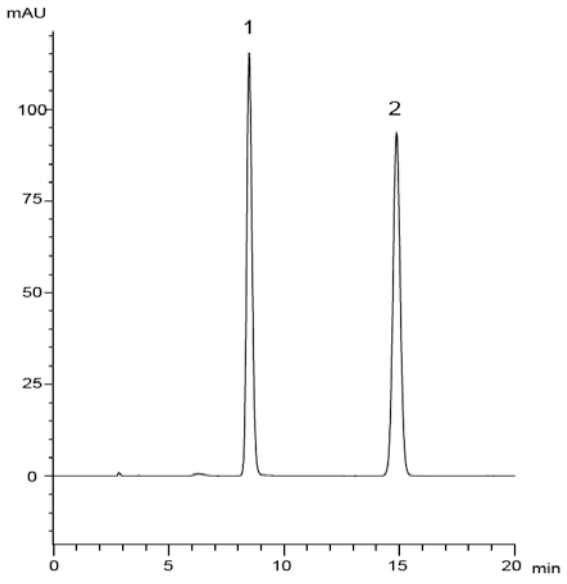

Lincomycin hydrochloride

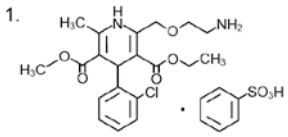



Clindamycin hydrochloride

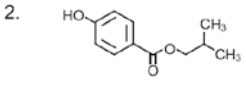
| | |
|---|---|
| Column: | YMC-TriArt C18 (5 µm, 12 nm) |
| Dimension: | 250 x 4.6 mm ID |
| Part-No.: | TA12S052546PT |
| Eluent: | 50 mM $KH_2PO_4$ (pH 7.5 adjusted by 8 M KOH) / acetonitrile (55/45) |
| Flow rate: | 1.0 ml/min |
| Temperature: | 25 °C |
| Detection: | UV at 210 nm |
| Injection: | 10 µl |

## Analysis of amlodipine besilate



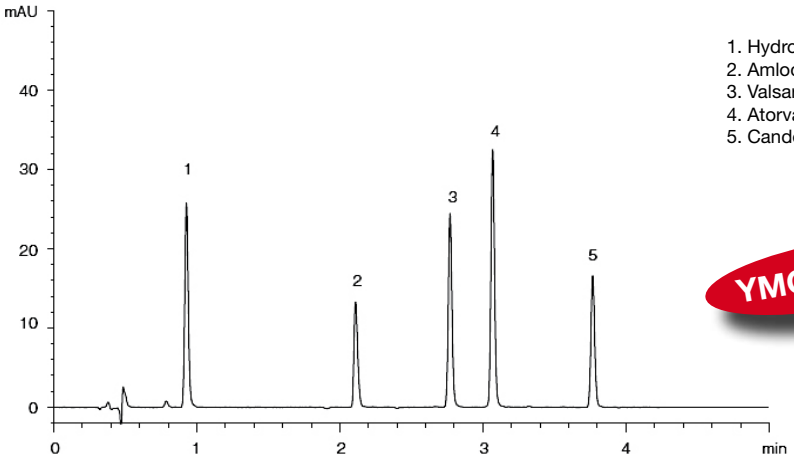

Amlodipine besilate




Isobutyl *p*-hydroxybenzoate

| | |
|---|---|
| Column: | YMC-TriArt C18 (5 µm, 12 nm) |
| Dimension: | 150 x 3.0 mm ID |
| Part-No.: | TA12S051503PT |
| Eluent: | 10 mM $CH_3COOH$-$CH_3COONH_4$ (pH 4.2) / acetonitrile (75/25) |
| Flow rate: | 0.425 ml/min |
| Temperature: | 40 °C |
| Detection: | UV at 254 nm |
| Injection: | 4 µl (0.02 ~ 0.3 mg/ml) |

## Basic drugs

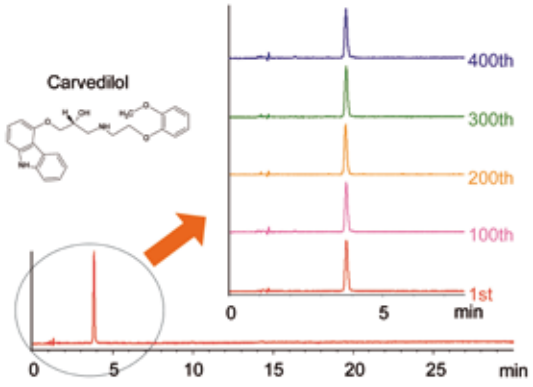


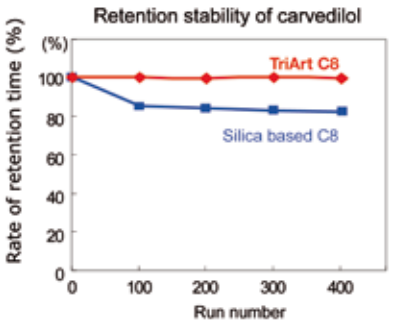

1. Hydrochlorothiazide
2. Amlodipine besilate
3. Valsartan
4. Atorvastatin calcium hydrate
5. Candesartan cilexetil

YMC-TriArt C8

| | | | |
|---|---|---|---|
| Column: | YMC-TriArt C8 (3 µm, 12 nm), 50 x 2.0 mm ID | Flow rate: | 0.4 ml/min |
| Part-No.: | TO12S030502PT | Temperature: | 30 °C |
| Eluent: | A) water / formic acid (100/0.1) | Detection: | UV at 254 nm |
| | B) acetonitrile / formic acid (100/0.1) | Injection: | 2 µl (10-20 µg/ml) |
| | 10-90% B (0-5 min), 90% B (5-7 min) | | |

## Sequential analysis of Carvedilol



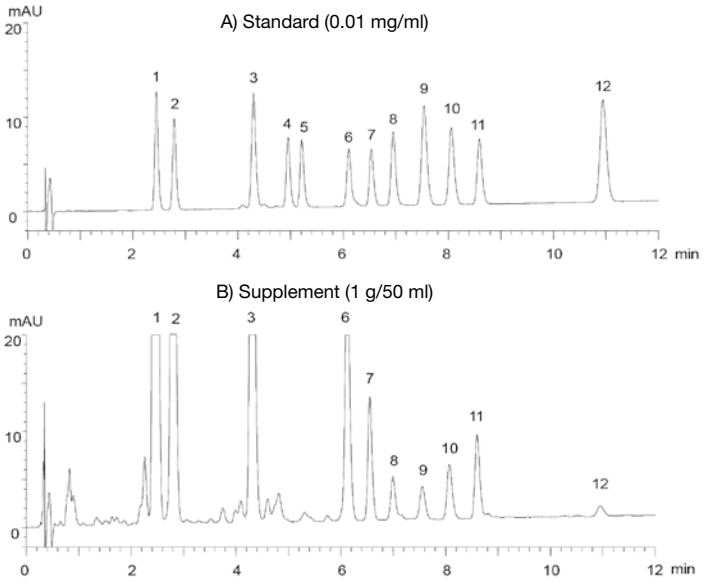

YMC-TriArt C8

| | |
|---|---|
| Column: | YMC-TriArt C8 (5 µm, 150 x 2.0 mm ID) |
| Part-No.: | TO12S051502PT |
| Eluent: | phosphate buffer (pH 2.0)* / acetonitrile (65/35) |
| | *Dissolve 2.72 g of $KH_2PO_4$ in 900 ml water, adjust pH 2.0 with $H_3PO_4$ and add water to make 1000 ml |
| Flow rate: | 0.28 ml/min (adjust the flow rate so that the retention time of carvedilol is about 4 min) |
| Temperature: | 55 °C |
| Detection: | UV at 240 nm |

No change in retention time is observed even under a high pH and at a elevated temperature.

Schöttmannshof 19 · D-46539 Dinslaken · Phone +49 (0) 20 64 427-0 · Telefax +49 (0) 20 64 427-222
E-Mail: info@ymc.de · www.ymc.de

## Soy isoflavones in supplement



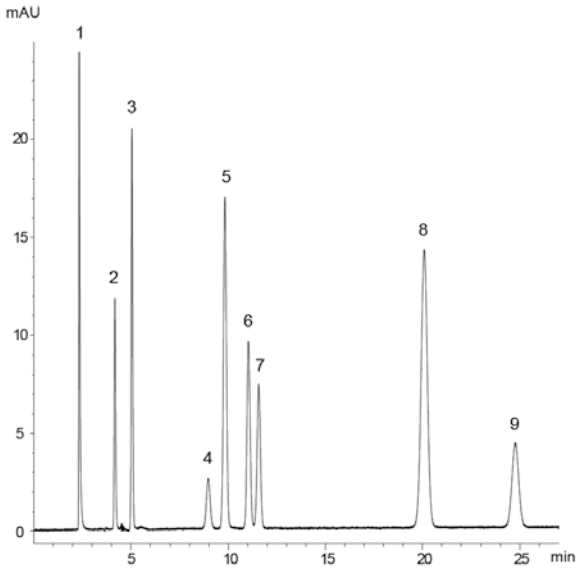

1. Daidzin
2. Glycitin
3. Genistin
4. 6“-*O*-Malonyldaidzin
5. 6“-*O*-Malonylglycitin
6. 6“-*O*-Acetyldaidzin
7. 6“-*O*-Acetylglycitin
8. 6“-*O*-Malonylgenistin
9. Daidzein
10. Glycitein
11. 6“-*O*-Acetylgenistin
12. Genistein

| | | | |
|---|---|---|---|
| Column: | YMC-TriArt C18 (3 µm, 12 nm) 50 x 2.0 mm ID | Flow rate: | 0.4 ml/min |
| Eluent: | A) acetonitrile / water / HCOOH (10/90/0.1) | Temperature: | 25 °C |
| | B) acetonitrile / water / HCOOH (60/40/0.1) | Detection: | UV at 254 nm |
| Gradient: | 5-40% B (0-12 min) | Injection: | 2 µl |

**Sample preparation method**

Supplement
← 50% aqueous ethanol
Stirred at r.t. for 1 hr
Filtration
Injection

## Separation of water-soluble vitamins



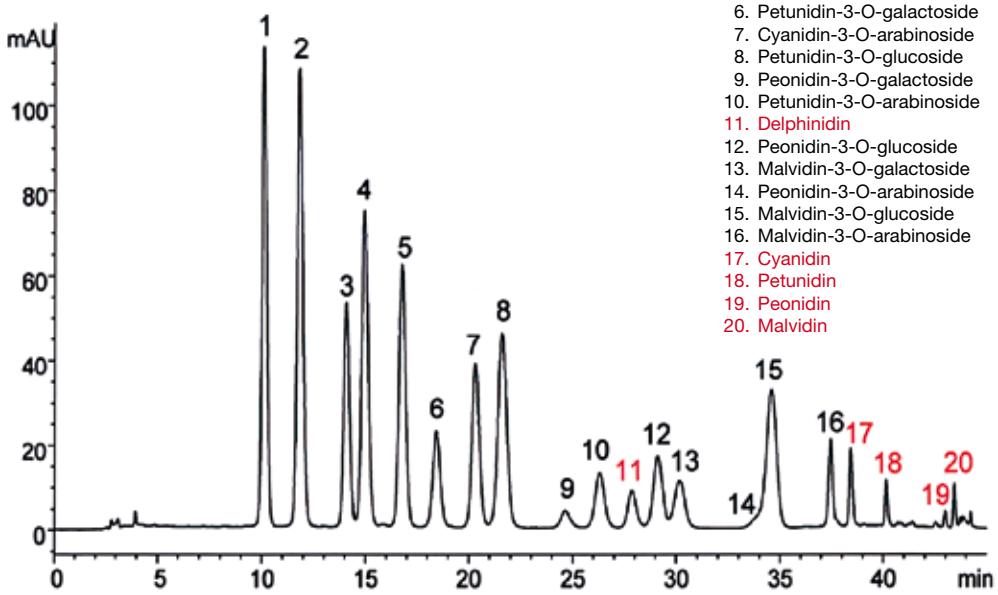

1. Thiamine HCl (Vitamin $B_1$)
2. Pyridoxine HCl (Vitamin $B_6$)
3. Nicotinamide
4. Cyanocobalamin (Vitamin $B_{12}$)
5. L-Ascorbic acid 2-glucoside
6. L-Ascorbic acid (Vitamin C)
7. Erythorbic acid
8. Riboflavin (Vitamin $B_2$)
9. Nicotinic acid

| | |
|---|---|
| Column: | YMC-TriArt C18 (5 µm, 12 nm) 250 x 4.6 mm ID |
| Part-No.: | TA12S052546PT |
| Eluent: | phospate buffer* / acetonitrile (90/10) *Dissolve 1.4 g $KH_2PO_4$ in 800 ml water → add 26 ml 10% TBA·OH → adjust pH 5.2 by 20% $H_3PO_4$ → add water to make 1000 ml |
| Flow rate: | 0.8 ml/min |
| Temperature: | 40 °C |
| Detection: | UV at 260 nm |
| Injection: | 10 µl (5 µg/ml) |

Schöttmannshof 19 · D-46539 Dinslaken · Phone +49 (0) 20 64 427-0 · Telefax +49 (0) 20 64 427-222
E-Mail: info@ymc.de · www.ymc.de

# Analysis of anthocyanins and anthocyanidins

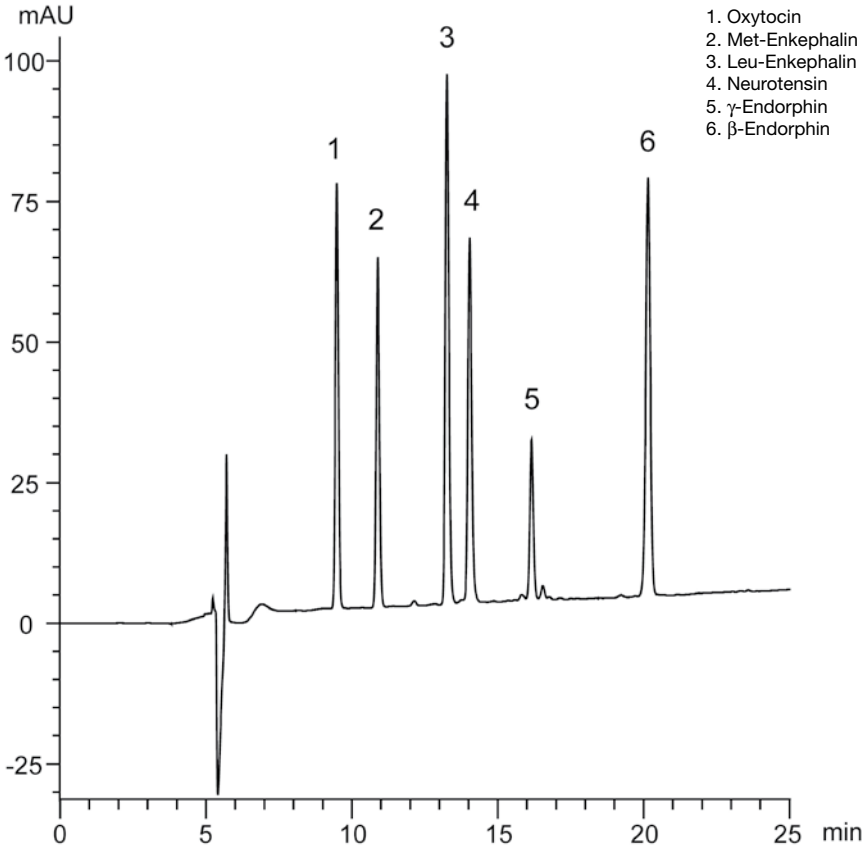
Anthocyanins: Indicated in black
Anthocyanidins: Indicated in red




1. Delphinidin-3-O-galactoside
2. Delphinidin-3-O-glucoside
3. Cyanidin-3-O-galactoside
4. Delphinidin-3-O-arabinoside
5. Cyanidin-3-O-glucoside
6. Petunidin-3-O-galactoside
7. Cyanidin-3-O-arabinoside
8. Petunidin-3-O-glucoside
9. Peonidin-3-O-galactoside
10. Petunidin-3-O-arabinoside
11. Delphinidin
12. Peonidin-3-O-glucoside
13. Malvidin-3-O-galactoside
14. Peonidin-3-O-arabinoside
15. Malvidin-3-O-glucoside
16. Malvidin-3-O-arabinoside
17. Cyanidin
18. Petunidin
19. Peonidin
20. Malvidin

| | |
|---|---|
| Column: | YMC-TriArt C18 (5 µm, 12 nm) 250 x 4.6 mm ID |
| Part-No.: | TA12S052546PT |
| Eluent: | A) water / formic acid (90/10) |
| | B) acetonitrile / methanol / water / formic acid (22.5/22.5/40/10) |
| Gradient: | 20-28% B (0-30 min), 28-70% B (30-40 min), 100% B (40-45 min) |
| Flow rate: | 1.0 ml/min |
| Temperature: | 25 °C |
| Detection: | UV/VIS at 535 nm |
| Sample: | commercial bilberry powder (1.25 mg/ml) |

# Peptides (MW 556 - 3,465)



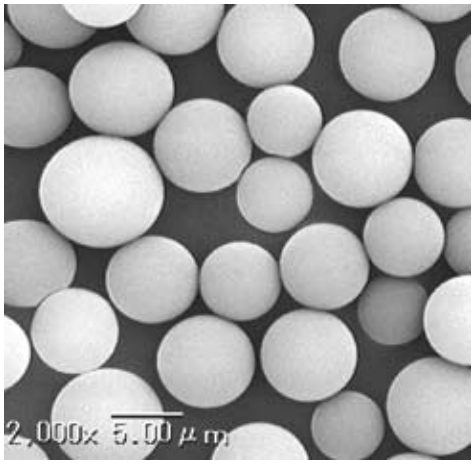

1. Oxytocin (MW 1,007)
2. Met-Enkephalin (MW 574)
3. Leu-Enkephalin (MW 556)
4. Neurotensin (MW 1,673)
5. γ-Endorphin (MW 1,859)
6. β-Endorphin (MW 3,465)

| | | | |
|---|---|---|---|
| Column: | YMC-TriArt C18 (5 µm, 12 nm) | Flow rate: | 0.2 ml/min |
| Dimension: | 150 x 2.0 mm ID | Temperature: | 37 °C |
| Part-No.: | TA12S051502PT | Detection: | UV at 220 nm |
| Eluent: | A) water / TFA (100/0.1)<br>B) acetonitrile / TFA (100/0.1)<br>20-45% B (0-25 min) | Injection: | 2 ml (0.075 ~ 0.25 mg/ml) |

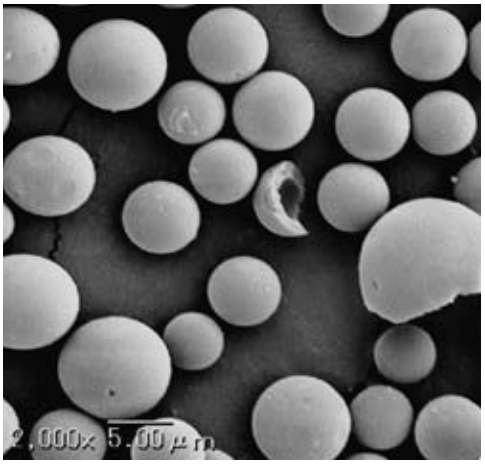
# YMC-TriArt: Improved quality of particles

## Uniform spherical particles

YMC-TriArt

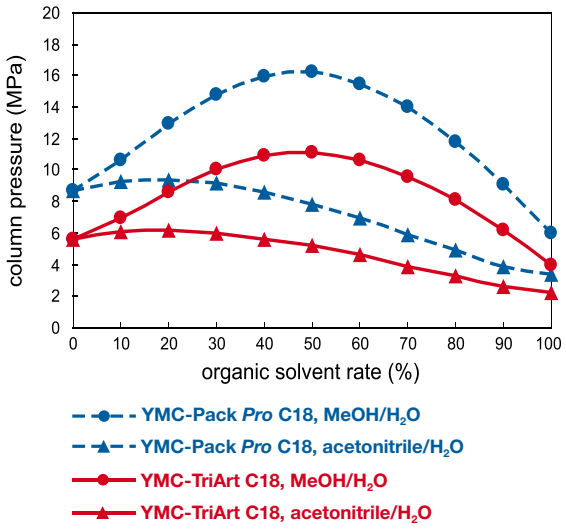



X-Bridge HILIC




The new uniform spherical particle support is used for YMC-TriArt C18 and C8. The particle is produced using **micro-reactor** technology for the granulation process. This results in reduction of the back-pressure and leads to more reproducibility in surface modification.

## Low column back-pressure




| | |
|---|---|
| Column: | YMC-TriArt C18, 5 µm, 150 x 4.6 mm ID |
| Part-No.: | TA12S051546PT |
| Eluent: | acetonitrile / water or methanol / water |
| Flow rate: | 1.0 ml/min |
| Temperature: | 25 °C |

The revolutionary production technique, adapted from micro-reactor flow technology, produces a multi-layered silica/organic hybrid stationary phase, with outstanding narrow pore size and particle size distributions which result in low back pressures.

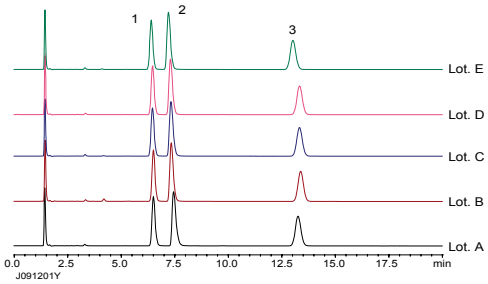
YMC-TriArt C18 is designed for use under many conditions. Elution with higher viscosity methanol (compared with acetonitrile), YMC-TriArt C18 generates lower pressure (approx 30% lower than with conventional phases).

Schöttmannshof 19 · D-46539 Dinslaken · Phone +49 (0) 20 64 427-0 · Telefax +49 (0) 20 64 427-222
E-Mail: info@ymc.de · www.ymc.de

# Batch-to-Batch reproducibility

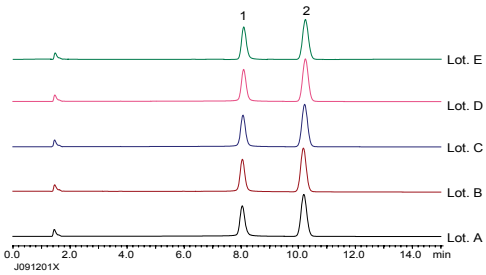
Excellent reproducibility of YMC-TriArt C18 and C8 is available even for the analysis for basic and coordination compounds which normally exhibit tailing and adsorption effects.

## Basic compounds



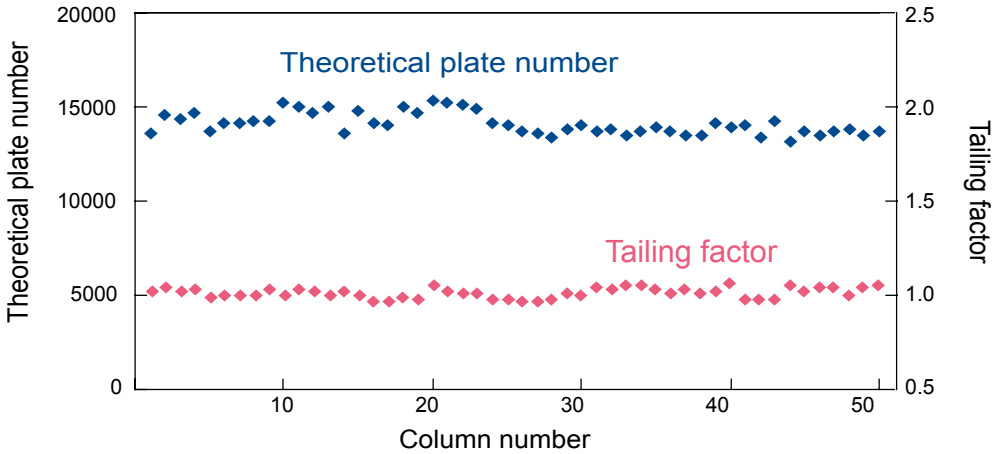

| | |
|---|---|
| Column: | YMC-TriArt C18, 5 µm, 150 x 3.0 mm ID |
| Eluent: | 20 mM $KH_2PO_4$ (pH 6.9) / acetonitrile (65/35) |
| Flow rate: | 0.425 ml/min |
| Temperature: | 40 °C |
| Detection: | UV at 235 nm |

## Coordination compounds




| | |
|---|---|
| Column: | YMC-TriArt C18, 5 µm, 150 x 3.0 mm ID |
| Eluent: | acetonitrile / 0.1% $H_3PO_4$ (40/60) |
| Flow rate: | 0.425 ml/min |
| Temperature: | 40 °C |
| Detection: | UV at 254 nm |

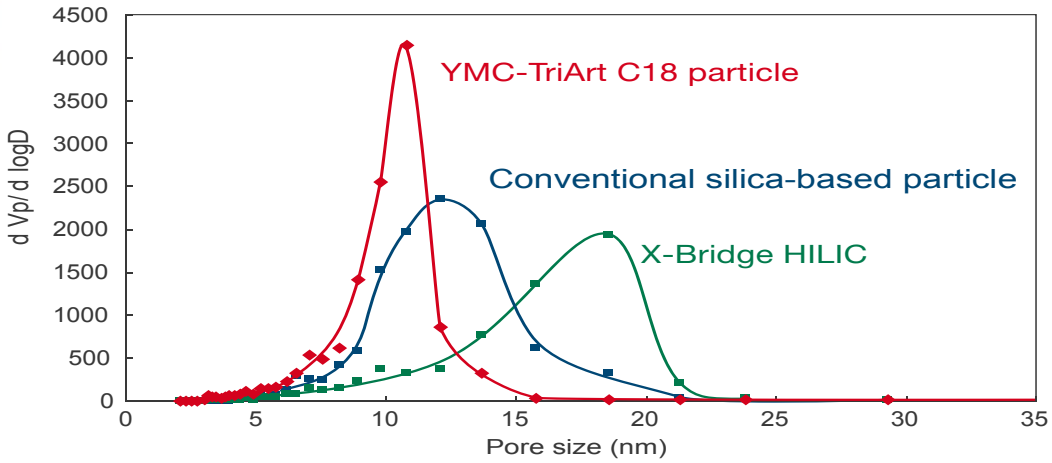
The reproducibility of packed columns is shown below in terms of theoretical plate number (N) and tailing factor (Tf). YMC-TriArt C18 and C8 packed columns exhibit a very narrow range of variation.




| | |
|---|---|
| Column: | YMC-TriArt C18, 5 µm, 150 x 4.6 mm ID |
| Part-No.: | TA12S051546PT |
| Eluent: | acetonitrile / water (40/60) |
| Flow rate: | 1.0 ml/min |
| Temperature: | ambient |
| Sample: | butyl benzoate |

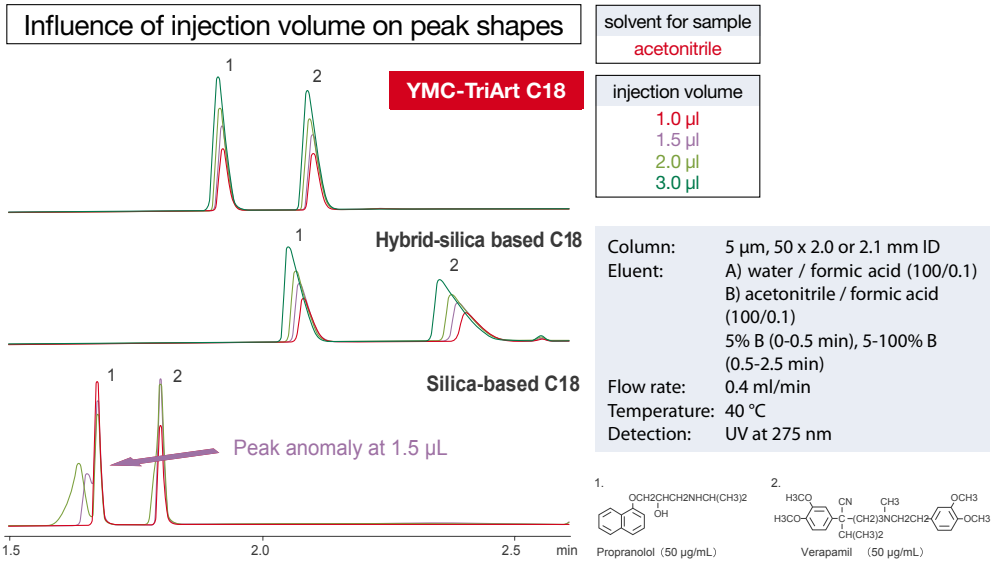
Schöttmannshof 19 · D-46539 Dinslaken · Phone +49 (0) 20 64 427-0 · Telefax +49 (0) 20 64 427-222
E-Mail: info@ymc.de · www.ymc.de

## Narrow pore distribution




This figure shows the pore size distributions of some competitive materials. Comparing the pore size distributions of some competitive materials shows that YMC-TriArt has a narrower distribution which results in sharper peak shapes.

## Improved loadability



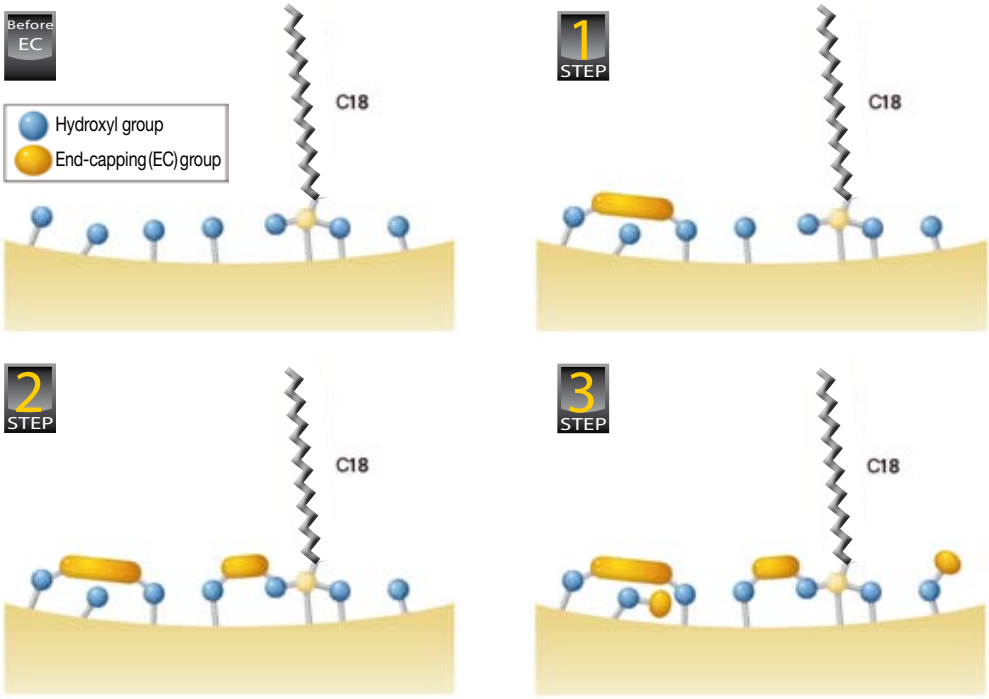

In order to prevent peak errors, there is the limit to the injection volume when the sample is injected in high elution solvents (such as 100% acetonitrile). Compared with traditional columns, more than double the injection volume can injected into YMC-TriArt columns as a result of the extremely narrow particle size distribution.

Schöttmannshof 19 · D-46539 Dinslaken · Phone +49 (0) 20 64 427-0 · Telefax +49 (0) 20 64 427-222
E-Mail: info@ymc.de · www.ymc.de

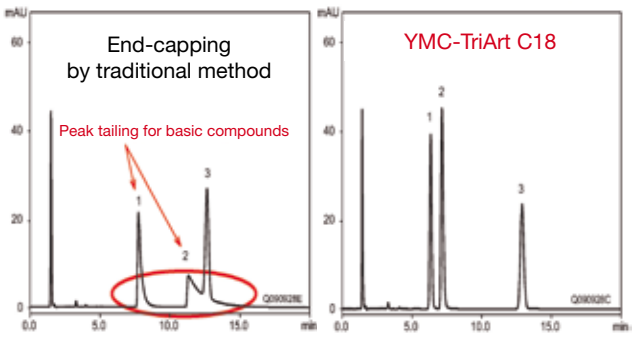
# Multi-stage endcapping

After bonding the alkyl chain, there are highly reactive and less reactive silanols on the surface. In traditional bonding processes, these are reacted with a single capping-compound in one step. However, the highly reactive silanols can be hydrolysed easily which contributes to the poor durability.The less reactive silanols are hard to endcap which results in poor resolution due to peak tailing.

YMC-TriArt C18 and C8 use a new innovation in end capping called "multistage endcapping" for its surface modification process. By using a number of compounds with the different reactivities in successive steps, all silanols can be capped to the maximum extent.




The chromatographic result of a "good" end-capping is demonstrated:



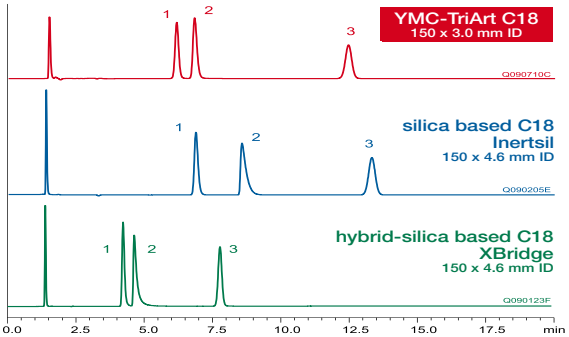

Ingredients in cough/cold medication:

1. Chlorpheniramine
2. Dextromethorphan
3. Propyl *p*-hydroxybenzoate

| | |
|---|---|
| Column: | 5 µm, 150 x 3.0 mm ID |
| Part-No.: | TA12S051503PT |
| Eluent: | 20 mM $KH_2PO_4$-$K_2HPO_4$ (pH 6.9) / acetonitrile (65/35) |
| Flow rate: | 0.425 ml/min |
| Temperature: | 40 °C |
| Detection: | UV at 235 nm |

Schöttmannshof 19 · D-46539 Dinslaken · Phone +49 (0) 20 64 427-0 · Telefax +49 (0) 20 64 427-222
E-Mail: info@ymc.de · www.ymc.de

## Basic compounds



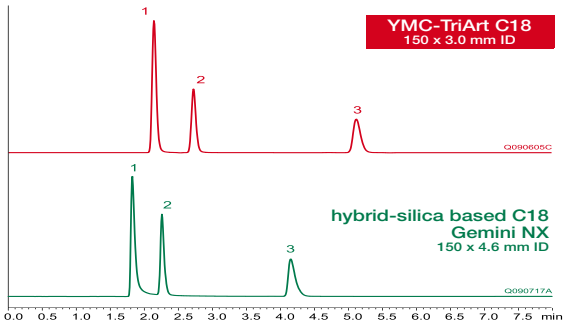

Ingredients in a cough/cold medication

1. Chlorpheniramine
2. Dextromethorphan
3. Propyl p-hydroxybenzoate

| | |
|---|---|
| Column: | 5 µm, 150 x 3.0 or 150 x 4.6 mm ID |
| Eluent: | 20 mM $KH_2PO_4$-$K_2HPO_4$ (pH 6.9) / acetonitrile (65/35) |
| Flow rate: | 0.425 ml/min for 3.0 mm ID<br>1.0 ml/min for 4.6 mm ID |
| Temperature: | 40 °C |
| Detection: | UV at 235 nm |

The innovative surface modification technology results in excellent peak shapes even for basic compounds that often exhibit peak tailing with conventional silica- and hybrid silica-based reversed phase columns.

## Acidic compounds



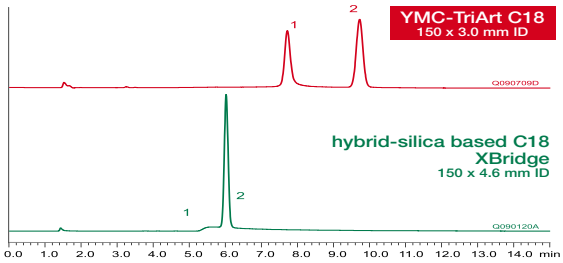

Organic acid

1. Formic acid
2. Acetic acid
3. Propionic acid

| | |
|---|---|
| Column: | 5 µm, 150 x 3.0 or 150 x 4.6 mm ID |
| Eluent: | methanol / 0.1% $H_3PO_4$ (5/95) |
| Flow rate: | 0.425 ml/min for 3.0 mm ID<br>1.0 ml/min for 4.6 mm ID |
| Temperature: | 37 °C |
| Detection: | UV at 210 nm |

YMC-TriArt phases is synthesised using methodology adapted from micro-reactor technology. This technique ensures a reduction of impurities that contribute to peak tailing during the analysis of some types acidic compounds.

## Coordinating compounds




Hinokitiol

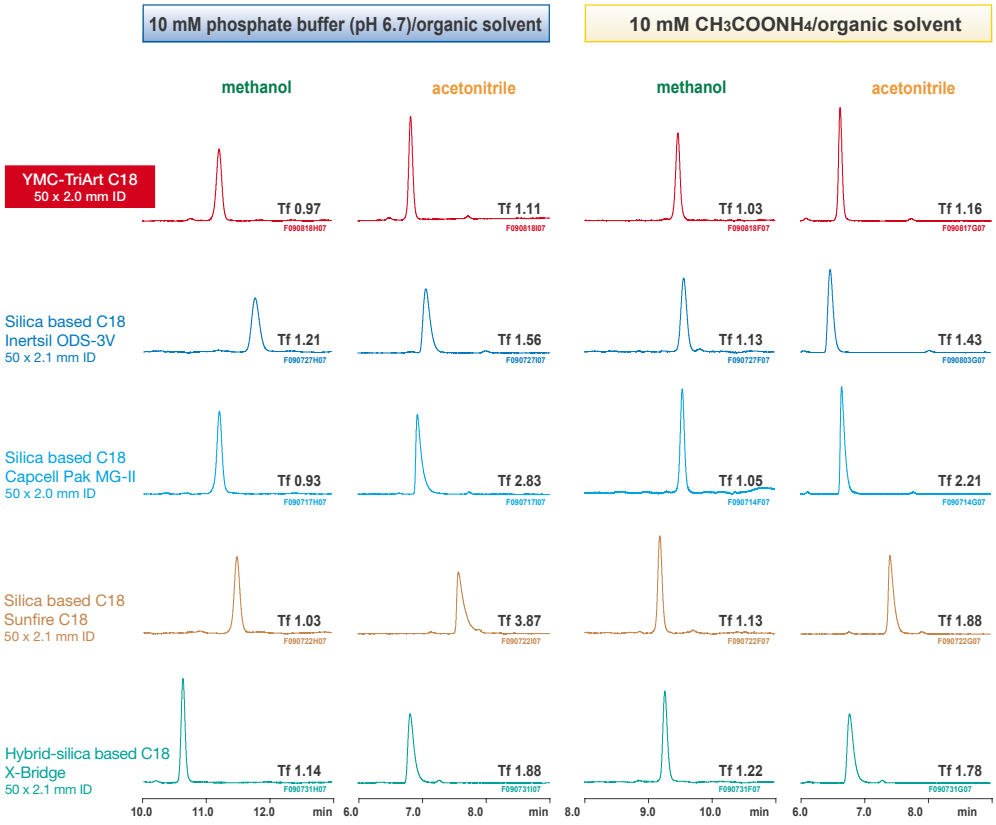
1. Hinokitiol
2. Methyl benzoate

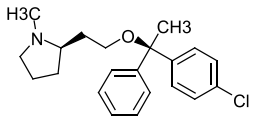
| | |
|---|---|
| Column: | 5 µm, 150 x 3.0 or 150 x 4.6 mm ID |
| Eluent: | acetonitrile / 0.1% $H_3PO_4$ (40/60) |
| Flow rate: | 0.425 ml/min for 3.0 mm ID<br>1.0 ml/min for 4.6 mm ID |
| Temperature: | 40 °C |
| Detection: | UV at 254 nm |

YMC-TriArt phases have an extremely low level of metal impurities, much lower than conventional products, ensuring excellent peak shape for coordination compounds.

Schöttmannshof 19 · D-46539 Dinslaken · Phone +49 (0) 20 64 427-0 · Telefax +49 (0) 20 64 427-222
E-Mail: info@ymc.de · www.ymc.de

# Comparison of clemastine analysis




Clemastine

| | |
|---|---|
| Column: | 5 µm, 50 x 2.0 or 50 x 2.1 mm ID |
| Eluent: | A) 10 mM $KH_2PO_4$-$K_2HPO_4$ (pH 6.7) or 10 mM $CH_3COONH_4$ |
| | B) methanol or acetonitrile |
| | 5-90% B (0-10 min), 90% B (10-15 min) |
| Flow rate: | 0.2 ml/min |
| Temperature: | 25 °C |
| Detection: | UV at 230 nm |

Clemastine is a well-known basic compound which readily exhibits peak tailing with conventional ODS columns. YMC-TriArt C18 provides sharp separations with many different buffer/solvent compositions.

Schöttmannshof 19 · D-46539 Dinslaken · Phone +49 (0) 20 64 427-0 · Telefax +49 (0) 20 64 427-222
E-Mail: info@ymc.de · www.ymc.de

# Substance index



The following brands, trademarks, or service marks are the property of the listed company and/or its subsidiaries. Every effort has been taken to ensure this list is accurate at the time of printing this brochure.

SureFit is trademark of IDEX Corporation.
Capcell Pak MG-II, Capcell Pak C18 AQ are trademarks of Shiseido Co., Ltd.
Intertsil ODS-3V, Intertsil ODS-3, Intertsil ODS-4 are trademarks of GI Sciences.
Acquity UPLC BEH C18, Acquity UPLC CSH C18, Atlantis dC18, Atlantis T3, SunFire C18, Symmetry C18, X-Bridge C18, XTerra MS C18 are trademarks of Waters Corp.
Gemini, Gemini NX, Kinetex TM C18 are trademarks of Phenomenex , Inc.
Hypersil GOLD is a trademark of Thermo Fisher Scientific.
Kromasil Eternity is a trademark of EKA Chemicals.
TSK-gel ODS-100S is a trademark of Tosoh Bioscience LLC.
Zorbax Extend-C18, Zorbax StableBond, Zorbax Eclipse Plus are trademarks of Agilent.
L-column is a trademark of Chemicals Evaluation and Research Institute.

Schöttmannshof 19 · D-46539 Dinslaken · Phone +49 (0) 20 64 427-0 · Telefax +49 (0) 20 64 427-222
E-Mail: info@ymc.de · www.ymc.de

# Ordering Information

## YMC-TriArt 1.9 µm UHPLC columns

| Phase | Column ID (mm) | Column length (mm) 20 | 30 | 50 | 75 | 100 | 150 |
|---|---|---|---|---|---|---|---|
| C18 | 2.0 | TA12SP90202PT | TA12SP90302PT | TA12SP90502PT | TA12SP9L502PT | TA12SP91002PT | TA12SP91502PT |
| | 3.0 | — | TA12SP90303PT | TA12SP90503PT | TA12SP9L503PT | TA12SP91003PT | — |
| C8 | 2.0 | TO12SP90202PT | TO12SP90302PT | TO12SP90502PT | TO12SP9L502PT | TO12SP91002PT | TO12SP91502PT |
| | 3.0 | — | TO12SP90303PT | TO12SP90503PT | TO12SP9L503PT | TO12SP91003PT | — |

## YMC-TriArt 3 µm analytical columns

| Phase | Column ID (mm) | Column length (mm) 50 | 75 | 100 | 150 | 250 | Guard cartridges with 10 mm length (pack of 5) |
|---|---|---|---|---|---|---|---|
| C18 | 2.0 | TA12S030502WT | TA12S03L502WT | TA12S031002WT | TA12S031502WT | — | TA12S030102 |
| | 3.0 | TA12S030503WT | TA12S03L503WT | TA12S031003WT | TA12S031503WT | — | TA12S030103 |
| | 4.6 | TA12S030546WT | TA12S03L546WT | TA12S031046WT | TA12S031546WT | TA12S032546WT | TA12S030104 |
| C8 | 2.0 | TO12S030502WT | TO12S03L502WT | TO12S031002WT | TO12S031502WT | — | TO12S030102 |
| | 3.0 | TO12S030503WT | TO12S03L503WT | TO12S031003WT | TO12S031503WT | — | TO12S030103 |
| | 4.6 | TO12S030546WT | TO12S03L546WT | TO12S031046WT | TO12S031546WT | TO12S032546WT | TO12S030104 |

## YMC-TriArt 5 µm analytical columns

| Phase | Column ID (mm) | Column length (mm) 50 | 75 | 100 | 150 | 250 | Guard cartridges with 10 mm length (pack of 5) |
|---|---|---|---|---|---|---|---|
| C18 | 2.0 | TA12S050502WT | TA12S05L502WT | TA12S051002WT | TA12S051502WT | — | TA12S050102 |
| | 3.0 | TA12S050503WT | TA12S05L503WT | TA12S051003WT | TA12S051503WT | — | TA12S050103 |
| | 4.6 | TA12S050546WT | TA12S05L546WT | TA12S051046WT | TA12S051546WT | TA12S052546WT | TA12S050104 |
| C8 | 2.0 | TO12S050502WT | TO12S05L502WT | TO12S051002WT | TO12S051502WT | — | TO12S050102 |
| | 3.0 | TO12S050503WT | TO12S05L503WT | TO12S051003WT | TO12S051503WT | — | TO12S050103 |
| | 4.6 | TO12S050546WT | TO12S05L546WT | TO12S051046WT | TO12S051546WT | TO12S052546WT | TO12S050104 |

## YMC-TriArt , 12 nm, 5 µm in ACTUS high-throughput semipreparative hardware

| Phase | Column ID (mm) | Column length (mm) 50 | 75 | 100 | 150 |
|---|---|---|---|---|---|
| C18 | 10.0 | TA12S050510WX | — | TA12S051010WX | TA12S051510WX |
| | 20.0 | TA12S050520WX | — | TA12S051020WX | TA12S051520WX |
| | 30.0 | TA12S050530WX | TA12S05L530WX | TA12S051030WX | TA12S051530WX |
| C8 | 10.0 | TO12S050510WX | — | TO12S051010WX | TO12S051510WX |
| | 20.0 | TO12S050520WX | — | TO12S051020WX | TO12S051520WX |
| | 30.0 | TO12S050530WX | TO12S05L530WX | TO12S051030WX | TO12S051530WX |

## YMC-TriArt , preparative bulk media, also available in 10 and 15 µm.

Available in pack sizes 100 mg, 500 mg, 1 kg, 5 kg

Schöttmannshof 19 · D-46539 Dinslaken · Phone +49 (0) 20 64 427-0 · Telefax +49 (0) 20 64 427-222
E-Mail: info@ymc.de · www.ymc.de


Your local distributor:

**YMC Co., Ltd.**
YMC Karasuma-Gojo Bld. 284 Daigo-cho,
Karasuma Nisiiru Gojo-dori Shimogyo-ku,
Kyoto 600-8106 Japan
TEL. +81(0)75-342-4515, FAX +81(0)75-342-4550
www.ymc.co.jp

**YMC Europe GmbH**
Schöttmannshof 19
D-46539 Dinslaken
Germany
TEL. +49(0)2064/427-0, FAX +49(0)2064/427-222
www.ymc.de

**YMC America, Inc.**
941 Marcon Boulevard Suite 301
Allentown, PA18109 USA
TEL. +1-610-266-8650, FAX +1-610-266-8652
www.ymcamerica.com

**YMC India Ltd.**
CX - 07, 3rd Floor, Lobe - 1,
Tower - A, The Corenthum, Plot No- A-41,
Sector - 62, Noida - 201301 (UP) India.
TEL. +91(0)120-4276020 - 25, FAX +91(0)120-4276026
www.ymcindia.com

**YMC Co., Ltd. Shanghai Rep. Office**
Far East International Plaza A2404
No. 319 Xianxia Road, Shanghai 200051
P.R. China
TEL: +86-21-6235-1388, FAX: +86-21-6235-1398