

Gas Chromatography

Capillary Column

Application Data



SHINWA CHEMICAL INDUSTRIES LTD.

ULBON Series

The capillary column performs very higher separation than the packed column because of the small diffusion and good permeability of the sample. The fused silica capillary column coated polyimide resin on the outside of tubing was developed in around 1980. The inert surface and flexibility of fused silica tubing lead to high performance separation and easy handling. To satisfy your analytical requirement, we are preparing various columns including the chemical bonding (HR) and wall coated types (WCOT).

Products List of Capillary column

	HR (Chemical Bond)		WCOT (Wall Coated Open Tubular)	
	Fused Silica	Inactive Processed Stainless Steel Tube	Fused Silica	Stainless Steel
General Purpose Type	ULBON HR-1 ULBON HR-52 ULBON HR-17 ULBON HR-1701 ULBON HR-20M			
Special Type	ULBON HR-SS-10 ULBON HR-Thermon-3000B ULBON HR-Thermon-600T ULBON HR-Thermon-HG	ULBON HR-TGC1	ULBON ALPhen ULBON DMN 267 ULBON PLC ULBON Xylene Master ULBON Advance-DS ULBON FFAP	ULBON SPX-1

“ULBON” is a generic name of the Shinwa capillary columns.

“ULBON HR” is a generic name of the Shinwa capillary columns with chemical bonding layer.

Column	Type	Feature	Material
ULBON HR Series	The chemical bond layer	ULBON HR series are capillary columns chemically bonded between silica surface and stationary phase.	Fused silica covered with polyimide resin Inactive processed stainless steel
ULBON WCOT Series	Wall Coated (Open Tubular)	Capillary column coated with stationary phase on the inner wall.	Fused silica covered with polyimide resin Stainless steel

ULBON HR Series

We have ten types of stationary phases for general analysis and each analytical purpose, as an ULBON HR series. We also stock the columns with various lengths, inner diameter and the film thickness of stationary phase for your requirement.

■ Characteristics

1. The inert inner surface of the column results in high quantitative analysis.

The adsorption point of the inner surface of the column has been completely removed by a rigid treatment. Therefore, free acid and free amine which are easily adsorbed are eluted without interaction with the active surface.

2. No exfoliation and bleeding of stationary phase lead to high sensitive analysis .

In HR series column, the rigid chemical bonding is treated on the surface, therefore there is almost no exfoliation and bleeding of stationary phase. No bleeding from the column results in the high sensitive analysis.

3. The maximum temperature is higher than that of ordinary WCOT column.

The maximum temperature of HR-20M (correspondence to PEG-20M) is 240 °C and HR-silicone series are 330 °C (except HR-1701 and HR-17). The maximum temperature of chemical bond type column rises about 70 °C compared with the WCOT type.

Capillary Column for General Purpose

For general analysis, we have five types of capillary columns chemically bonded with stationary phases having non-polar to polar.

- **ULBON HR-1 (Corresponding OV-1, OV-101)**
- **ULBON HR-52 (Corresponding SE-52)**
- **ULBON HR-17 (Corresponding OV-17)**
- **ULBON HR-1701 (Corresponding OV-1701)**
- **ULBON HR-20M (Corresponding PEG-20M)**

Capillary Column for Special Purpose

These capillary columns are coated with our original stationary phase developed for the special analytical purpose. A series of column is higher sensitivity and separation compared with the general analytical purpose type column.

1. For Fatty Acid Methyl Ester Analysis

- **ULBON HR-SS-10**
- **ULBON HR-Thermon-3000B**

The analysis of fatty acid methyl ester by the capillary column in GC is an important method in the field of biochemistry. Especially, the separation of *cis*, *trans* isomer and a regioisomer is indispensable for the analysis of the fatty acid ester.

Our company put **ULBON HR-SS-10** and **ULBON HR-Thermon-3000B** * on the market as a capillary column only for the analysis of fatty acid ester.

2. Excellent resolution for Perfumes and Refined Oils

- **ULBON HR-Thermon-600T**

It is indispensable to use the capillary gas chromatography, when essential oil and the perfumes are analyzed. The major component of essential oil and perfumes are terpenes, hydrocarbon having chain or cyclic structure of chemical formula of $(C_5H_8)_n$, and its derivatives which are chemically unstable alcohols, aldehydes and ketones.

It is necessary for the analysis of essential oil and perfumes that the chemical bond and technical inert treatment is perfectly performed. The stable and good technical treated column results in a high sensitive and a quantitative analysis. As an original capillary column for the essential oil and perfume, we recommend **ULBON HR-Thermon-600T** for your work.

3. For the Analysis of Organic Mercury (Methyl and Ethyl Mercury) and Tributyl Tin

- **ULBON HR-Thermon-HG**

ULBON HR-Thermon-HG is the best column for the analysis of the organic mercury that has already been regulated and the harmful substances such as tributyltin used for the stain-proofing agent of fishing net and the ship bottom paint.

In the analyses of TBTC (Tributyltin chloride) and alkylmercury, the use of packed column results in the poor reproducibility of the separation because of the adsorption to the material.

The adsorption phenomenon is extremely few on the **ULBON HR-Thermon-HG**, the high sensitive and reproducible quantity analysis are possible. ULBON HR-Thermon-HG is excellent separation abilities in the analysis of Tributyltin chloride compared with packed column because of the no adsorption phenomenon.

4. For the Analysis of Triglyceride (Stainless inside is processed inert treatment)

- **ULBON HR-TGC1**

The separation of triglyceride in the high boiling point range is difficult on the ordinary polyimide coated capillary column. However, triglyceride can be analyzed with stainless steel capillary column that has processed inert treatment inside and the newly developed heat-resistance stationary phase.

ULBON WCOT Series

5. For Alkyl Phenol Analysis

■ ULBON ALPhen

Isomers of the alkyl phenol compounds such as cresol, xylenes and ethyl phenols which are known to difficult substances to analyze can be completely separated with ULBON ALPhen.

- 1. All isomers of xylenol (six isomers) can be separated on the ULBON ALPhen, especially 2,4-Xylenol and 2,5-Xylenol are resolved completely.**
- 2. The separation of the isomers of the cresol and the ethyl phenol is excellent.**

ALPhen can offer you the best analysis of the alkyl phenol mentioned above.

6. For 2,6-, and 2,7-Dimethylnaphthalene Analysis

■ ULBON DMN267

Dimethylnaphthalene have ten isomers. Of ten isomers, the chemical and physical characteristics of 2,6-DMN and 2,7-DMN is very similar. The two isomers can be separated on the ULBON DMN267 (WCOT type) .

ULBON DMN267 has the following characteristics.

- 1. Maximum operation temperature is 160 °C. ULBON DMN267 is stable column.**
- 2. The column life is long.**

7. For Dimethylnaphthalene Isomers Analysis

■ ULBON PLC

Recently, high purity 2,6-Dimethylnaphthalene (DMN) has attracted attention as a high functional raw material of heat-resistance and the high strength resin. There are ten isomers of DMN. Because of the similar physical and chemical characteristics of DMN, the separation of 2,6-DMN and 2,7-DMN is especially difficult in gas chromatography. **ULBON PLC** is a capillary column to separate all isomers of DMN completely.

The stationary phase of **ULBON PLC** is a liquid crystal phase developed by our technical group. The operation temperature range (the appearance of liquid crystal state) as the stationary phase is 150-160 °C, and a fine separation of 2,7-DMN, 1,3-DMN and 2,6-DMN can be obtained by the proper control of the oven temperature.

To maintain good column performance, please take care of the following points.

- 1. Please analyze efficiently to prevent the deteriorate of stationary phase.**
- 2. When the analysis is temporarily interrupted, please adjust the temperature of the column oven to 50 °C or less or stop the apparatus without stopping the carrier gas.**
- 3. As for the carrier gas, nitrogen is more excellent than helium in the point of the separation and the detection sensitivity.**

8. For Xylene Isomers Analysis

■ ULBON Xylene Master

- 1. Xylene Master shows excellent separation because of the about 1.1 relative retention value for the isomer of xylene.**
- 2. The large separation capacity of Xylene Master capillary column and the inactive surface of fused silica used as a base material lead to perform the trace analysis of several ppm.**
- 3. The maximum operation temperature is 160 °C. The heat-resistance of Xylene Master is higher than that of the stationary phase of phthalic acid ester for general analysis. Therefore, the analysis of the alkyl benzene isomer with a high boiling point is also applicable.**

■ ULBON SPX-1 (SUS)

- 1. For the separation of impurities (for instance, *m*-xylene, Cumene and etc.) of *p*-xylene.**
- 2. SPX-1 is a stainless steel (SUS) capillary column coated with stationary phase of the halogenation phthalic acid ester structure (WCOT) .**
- 3. As for the analysis of *m*-xylene in *p*-xylene, the capillary column analysis is said to be a very difficult analysis so that *p*-xylene is eluted and then *m*-xylene in a usual GC analysis. Especially, small amount analysis of *m*-xylene is said to be an extremely difficult. *m*-Xylene of a small amount in front of *p*-xylene is eluted on the SPX-1. Therefore, the quantitative analysis is possible.**

ULBON Series

■ Specification

ULBON HR Series (General purpose type)

Column	Stationary Phase	Polarity	Maximum Temperature	Usage
HR-1 (Corresponding OV-1, OV-101)	Dimethyl silicone resin	Non	330°C	General analysis
HR-52 (Corresponding SE-52)	5%Phenylmethyl silicone	Low	330°C	General analysis
HR-17 (Corresponding OV-17)	50%Phenylmethyl silicone	Mid	300°C	Medicine, saccharide, TMS derivatives, phenols, steroids, and solvents
HR-1701 (Corresponding OV-1701)	14 % Cyanopropyl phenylmethyl silicone		280°C	
HR-20M (Corresponding PEG-20M)	Polyethyleneglycol	High	240°C	General analysis, polar compounds, esters, ketones and alcohols

ULBON HR Series (Special purpose type)

Column	Stationary Phase	Polarity	Maximum Temperature	Usage
HR-SS-10	Nitrile silicone	High	220°C/230°C	Fatty acid ester (especially, geometric isomer of C1=18 and C2=18)
HR-Thermon-3000B	Phthalic acid ester	High	220°C/230°C	Fatty acid esters (analysis of unsaturated C20)
HR-Thermon-600T	Phthalic ester	High	240°C	Essential oil, Perfume
HR-Thermon-HG	Alkyleneglycol Phthalic acid ester polymer	High	160°C	Methylmercury, Ethyl mercury, Tributyl tin
HR-TGC1	Phenylmethyl silicone	Low	360°C/390°C	Triglyceride

ULBON WCOT Series (Original)

Column	Maximum Temperature	Usage
ALPhen	160 °C	Alkyl phenols
DMN 267	160 °C	Dimethylnaphthalenes (separation of 2, 6- DMN, 2, and 7- DMN)
PLC	160 °C	Separation of all isomers of dimethylnaphthalene
Xylene Master	160 °C	Separation of isomer of xylene
Advance-DS	220 °C	Fatty acid methylic esters
FFAP	180 °C	Lower free fatty acids

ULBON WCOT Series (SUS)

Column	Maximum Temperature	Usage
SPX-1	110 °C	<i>m</i> -Xylene in <i>p</i> -Xylene The exclusive column for xylene isomer analysis
Squalane	70 °C	Hydrocarbon (Rigroin) The exclusive column for low hydrocarbon analysis

ULBON Series

Fixed Price List

ULBON HR Series (General purpose type)

Column	Inner Diameter (mm)	Film Thickness (μ m)	Length (m)	Price (Yen)
HR-1 (Corresponding OV-1, OV-101) 330°C	0.2	0.25	25	69,000
			50	127,000
	0.25	0.15	25	69,000
			30	77,000
			50	127,000
		0.25	25	69,000
			30	77,000
			50	127,000
		0.5	25	69,000
			30	77,000
			50	127,000
		0.32	25	75,000
			30	88,000
			50	130,000
		0.25	25	75,000
			30	88,000
			50	130,000
		0.5	25	75,000
			30	88,000
			50	130,000
		1	25	75,000
			30	88,000
			50	130,000
	0.53	1	15	61,000
			30	99,000
		2	15	61,000
			30	99,000
		3	15	61,000
			30	99,000
		5	15	61,000
			30	99,000

Column	Inner Diameter (mm)	Film Thickness (μ m)	Length (m)	Price (Yen)
HR-52 (Corresponding SE-52) 330°C	0.2	0.25	25	69,000
			50	127,000
	0.25	0.15	25	69,000
			30	77,000
			50	127,000
		0.25	25	69,000
			30	77,000
			50	127,000
		0.5	25	69,000
			30	77,000
			50	127,000
		0.32	25	75,000
			30	88,000
			50	130,000
		0.25	25	75,000
			30	88,000
			50	130,000
		0.5	25	75,000
			30	88,000
			50	130,000
		1	25	75,000
			30	88,000
			50	130,000
	0.53	1	15	61,000
			30	99,000
		2	15	61,000
			30	99,000
		3	15	61,000
			30	99,000
		5	15	61,000
			30	99,000

ULBON Series

Fixed Price List

ULBON HR Series (General purpose type)

Column	Inner Diameter (mm)	Film Thickness (μ m)	Length (m)	Price (Yen)
HR-17 (Corresponding OV-17) 300°C	0.25	0.25	25	69,000
			50	127,000
HR-1701 (Corresponding OV-1701) 280°C	0.2	0.25	25	69,000
			50	127,000
	0.25	0.15	25	69,000
			30	77,000
			50	127,000
		0.25	25	69,000
			30	77,000
			50	127,000
		0.5	25	69,000
			30	77,000
			50	127,000
	0.32	0.15	25	75,000
			30	88,000
			50	130,000
		0.25	25	69,000
			30	88,000
			50	130,000
		0.5	25	75,000
			30	88,000
			50	130,000
	1	25	25	75,000
			30	88,000
		50	25	75,000
			30	88,000
		130,000	25	75,000
			30	88,000
		130,000	25	75,000
			30	88,000
	0.53	1	15	61,000
			30	99,000
		2	15	61,000
			30	99,000
		3	15	61,000
			30	99,000
		5	15	61,000
			30	99,000

Column	Inner Diameter (mm)	Film Thickness (μ m)	Length (m)	Price (Yen)
HR-20M (Corresponding PEG-20M) 240°C	0.2	0.25	25	69,000
			50	127,000
	0.25	0.15	25	69,000
			30	77,000
			50	127,000
		0.25	25	69,000
			30	77,000
			50	127,000
		0.5	25	69,000
			30	77,000
			50	127,000
	0.32	0.15	25	75,000
			30	88,000
			50	130,000
		0.25	25	75,000
			30	88,000
			50	130,000
		0.5	25	75,000
			30	88,000
			50	130,000
	1	25	25	75,000
			30	88,000
		50	25	75,000
			30	88,000
		130,000	25	75,000
			30	88,000
		130,000	25	75,000
			30	88,000
	0.53	1	15	61,000
			30	99,000
		2	15	61,000
			30	99,000
		3	15	61,000
			30	99,000
		5	15	61,000
			30	99,000

ULBON Series

Fixed Price List

ULBON HR Series (Special purpose type)

Column	Inner diameter (mm)	Length (m)	Price (Yen)
HR-SS-10 220 °C/230 °C	0.25	25	69,000
		30	83,000
		50	127,000
	0.53	25	79,000
		30	91,000
		50	149,000
HR-Thermon-3000B 220 °C/230 °C	0.25	25	69,000
		30	83,000
		50	127,000
	0.32	25	77,000
		30	88,000
		50	143,000
	0.53	15	66,000
		30	108,000

Column	Inner diameter (mm)	Length (m)	Price (Yen)
HR-Thermon-600T 240 °C/240 °C	0.25	25	69,000
		30	82,000
		50	126,000
HR-Thermon-HG 160 °C	0.53	15	75,000
*HR-TGC1 360 °C/390 °C	0.25	30	59,000

ULBON WCOT Series (Original)

Column	Inner Diameter (mm)	Length (m)	Price (Yen)
ALPhen 160 °C	0.2	50	108,000
	0.32	50	132,000
DMN 267 160 °C	0.2	50	198,000
PLC 160 °C	0.25	50	180,000

Column	Inner Diameter (mm)	Length (m)	Price (Yen)
Xylene Master 160 °C	0.32	50	69,000
Advance-DS 220 °C	0.25	25	69,000
	0.25	30	77,000
	0.25	50	126,000

ULBON WCOT Series (SUS)

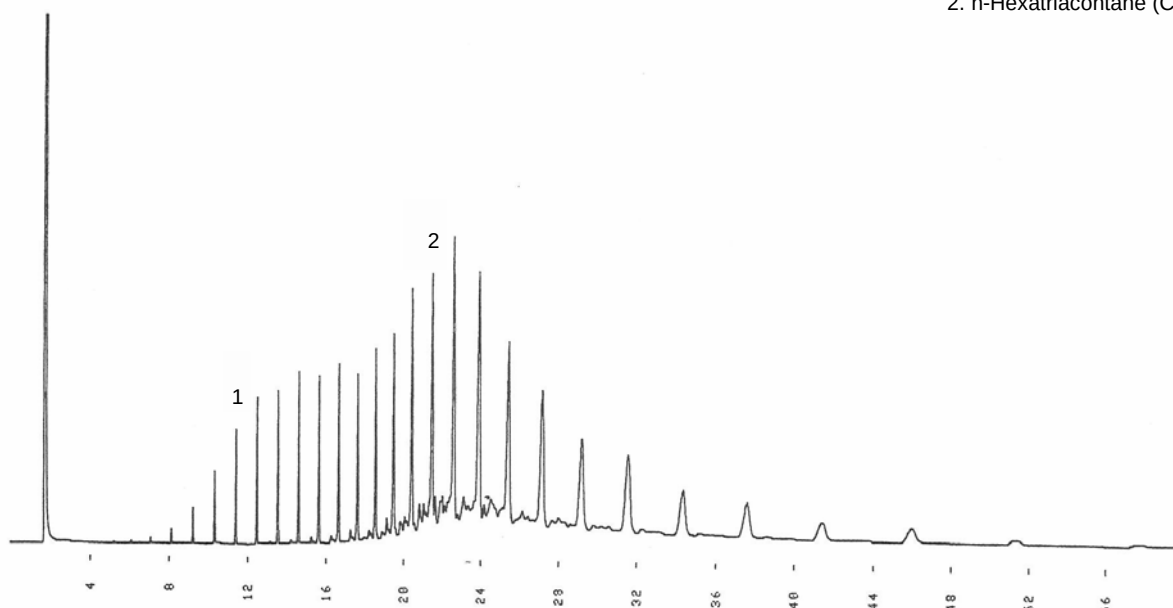
Column	Inner Diameter (mm)	Length (m)	Price (Yen)
SPX-1 10~110 °C	0.25	60	107,800
		90	140,800

Applications	Page
Hydrocarbons	10
Organic Solvents	18
Alcohols	22
Triglyceride	23
Fatty Acids and Esters	24
Perfume	31
Flower fragrance using NeedlEx for organic solvent	32
Food flavor using NeedlEx for organic solvent	34
Steroids	35
Environmental Pollutants	37
Others	41
Application Index	42
Product Index	51

Hydrocarbons

Paraffin wax (m.p. 68 ~ 70 °C)

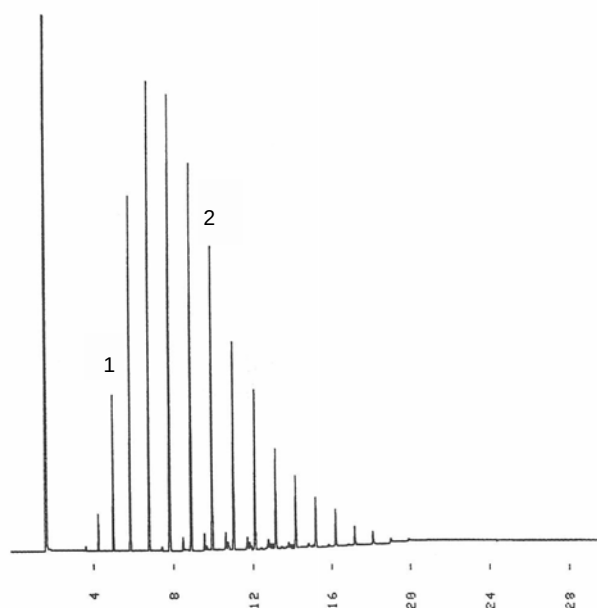
1. n-Hexacosane (C₂₆)
2. n-Hexatriacontane (C₃₆)



Column : ULBON HR-1 25 m x 0.25 mm I.D. df = 0.15 μ m
Column temp : 200 °C ~ 320 °C Program rate 6 °C/min
Injection : 330 °C (Split ratio: 53 :1)
Detector : FID (330 °C)
Carrier gas : He, 0.74 mL/min
Sample Volume: 1.0 μ L

Paraffin wax (m.p. 48 ~ 50 °C)

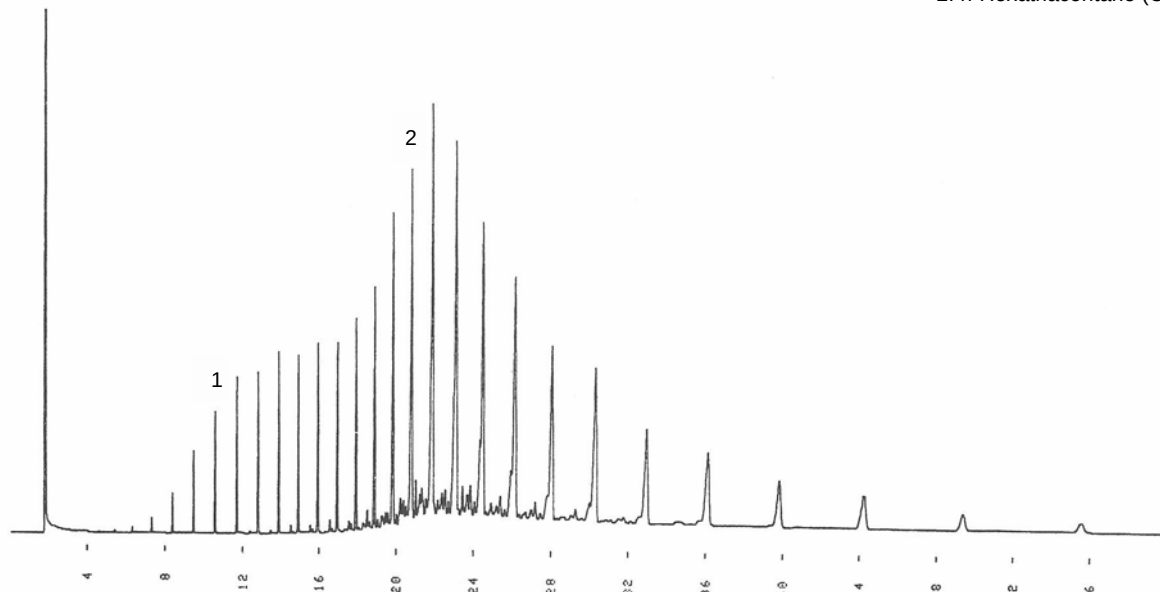
1. n-Eicosane (C₂₀)
2. n-Pentacosane (C₂₅)



Column : ULBON HR-1 25 m x 0.25 mm I.D. df = 0.15 μ m
Column temp : 200 °C ~ 320 °C Program rate 6 °C/min
Injection : 330 °C (Split ratio: 53 :1)
Detector : FID (330 °C)
Carrier gas : He, 0.74 mL/min
Sample Volume: 0.5 μ L

Paraffin wax (m.p. 68 ~ 70 °C)

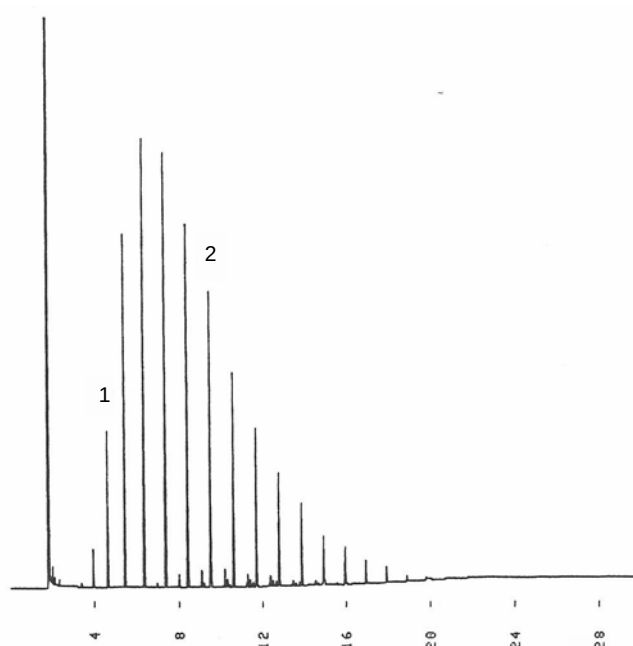
1. n-Hexacosane (C₂₆)
2. n-Hexatriacontane (C₃₆)



Column : ULBON HR-52 25 m x 0.25 mm I.D. df = 0.15 μ m
 Column temp : 200 °C ~ 320 °C Program rate 6 °C/min
 Injection : 330 °C (Split ratio: 56 :1)
 Detector : FID (330 °C)
 Carrier gas : He, 0.7 mL/min
 Sample Volume: 1.0 μ L

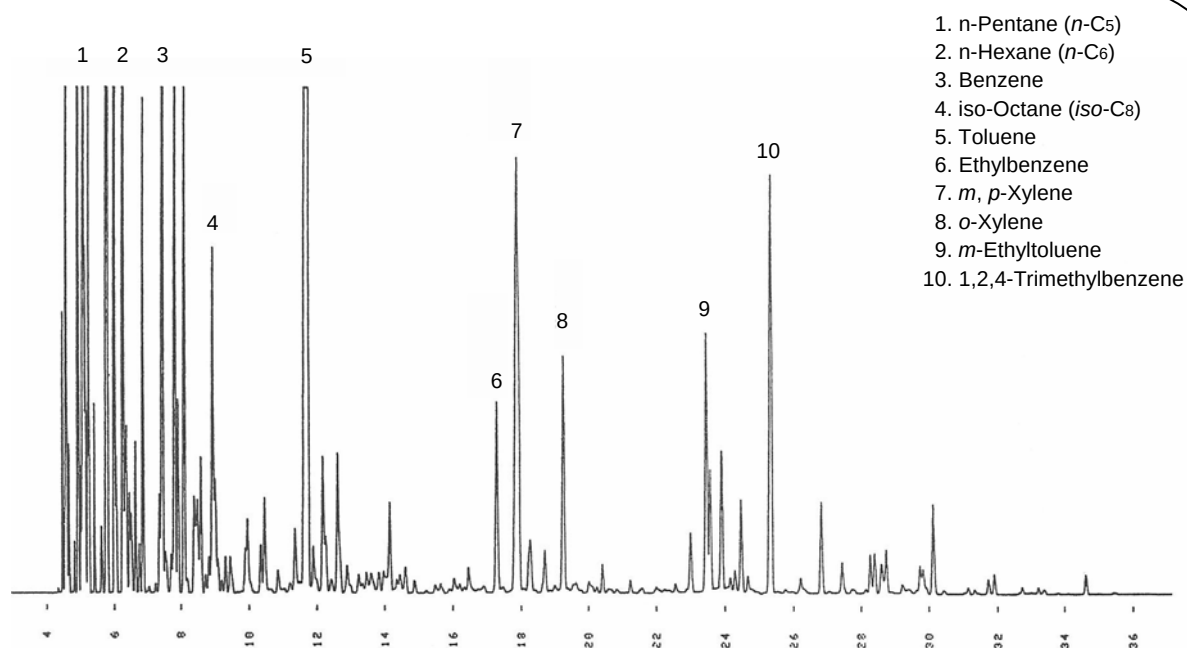
Paraffin wax (m.p. 48 ~ 50 °C)

1. n-Eicosane (C₂₀)
2. n-Pentacosane (C₂₅)



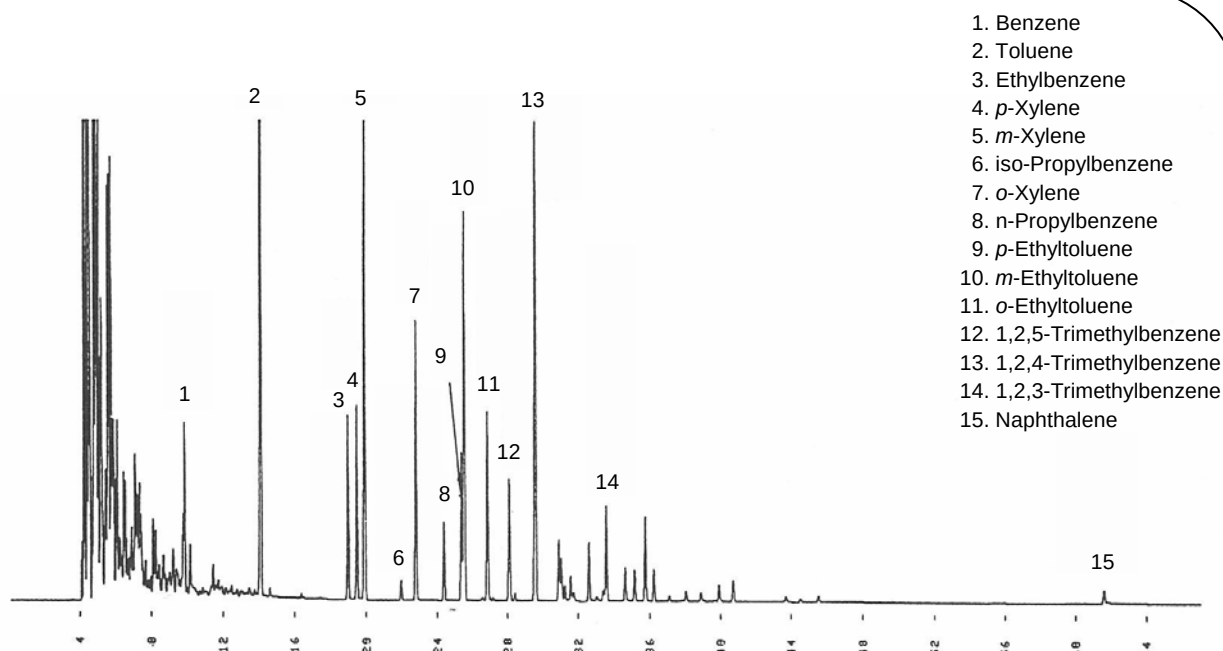
Column : ULBON HR-52 25 m x 0.25 mm I.D. df = 0.15 μ m
 Column temp : 200 °C ~ 320 °C Program rate 6 °C/min
 Injection : 330 °C (Split ratio: 56 :1)
 Detector : FID (330 °C)
 Carrier gas : He, 0.7 mL/min
 Sample Volume: 0.5 μ L

Regular gasoline



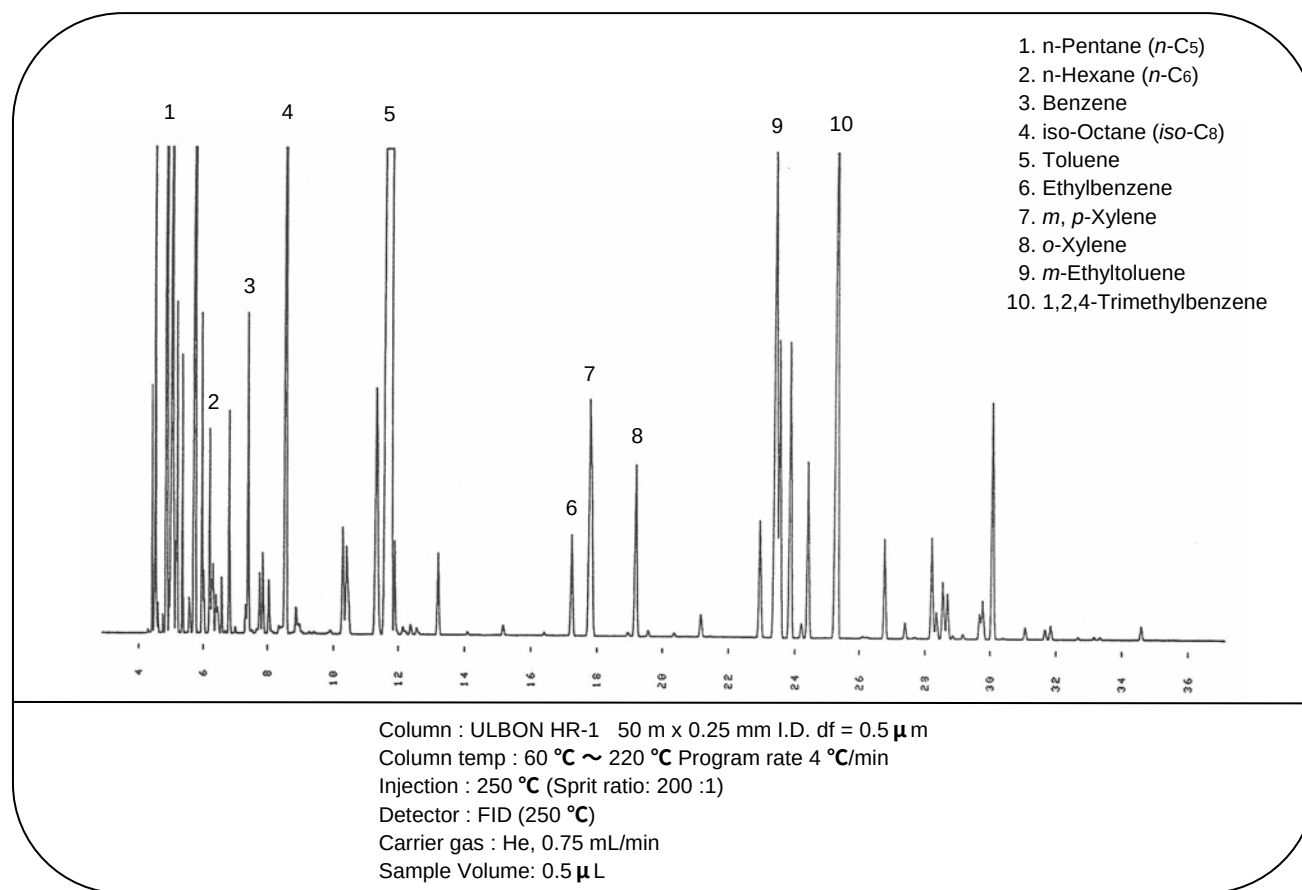
Column : ULBON HR-1 50 m x 0.25 mm I.D. df = 0.5 μ m
 Column temp : 60 °C ~ 220 °C Program rate 4 °C/min
 Injection : 250 °C (Split ratio: 200 :1)
 Detector : FID (250 °C)
 Carrier gas : He, 0.75 mL/min
 Sample Volume: 0.5 μ L

Aromatic hydrocarbons in Regular gasoline

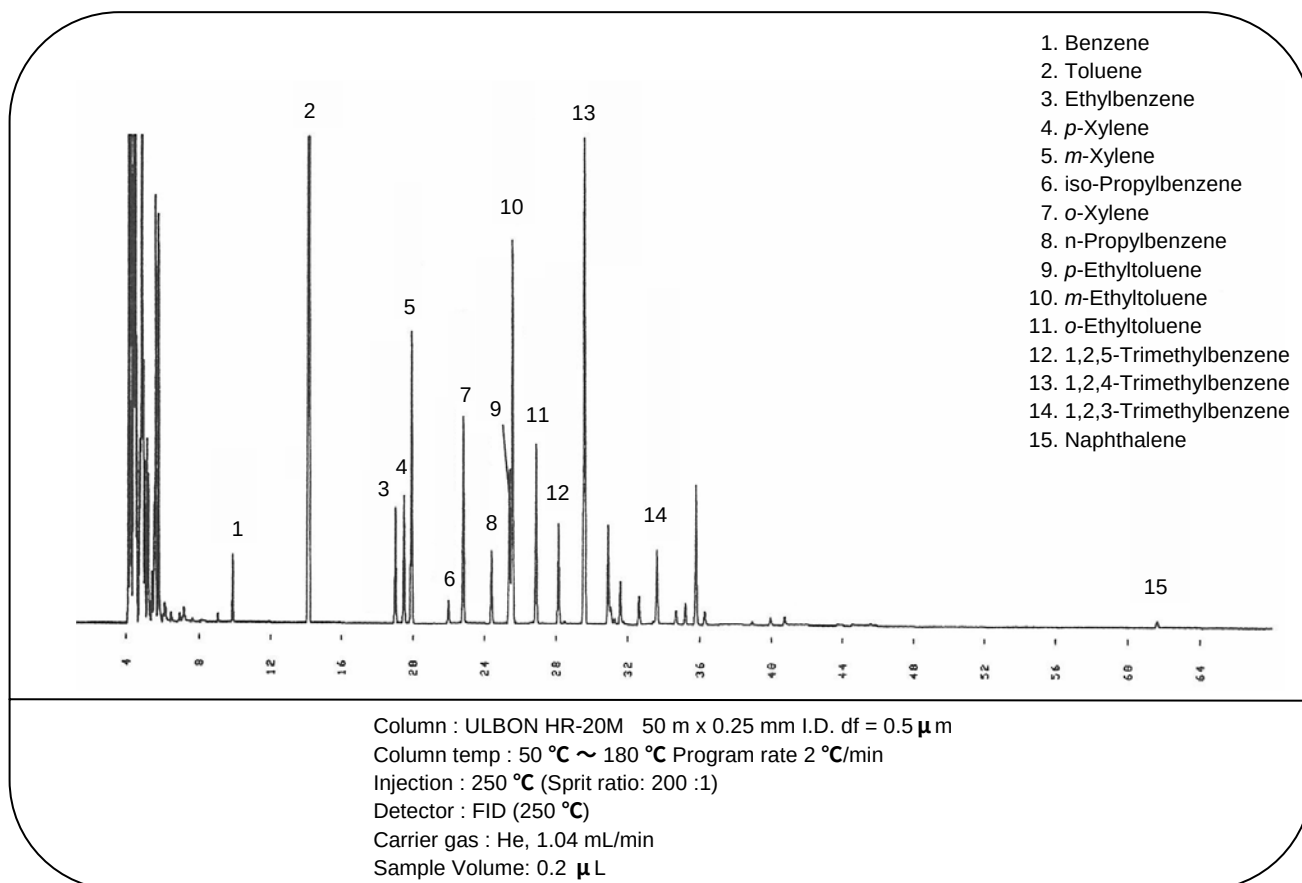


Column : ULBON HR-20M 50 m x 0.25 mm I.D. df = 0.5 μ m
 Column temp : 50 °C ~ 180 °C Program rate 2 °C/min
 Injection : 250 °C (Split ratio: 200 :1)
 Detector : FID (250 °C)
 Carrier gas : He, 1.04 mL/min
 Sample Volume: 0.2 μ L

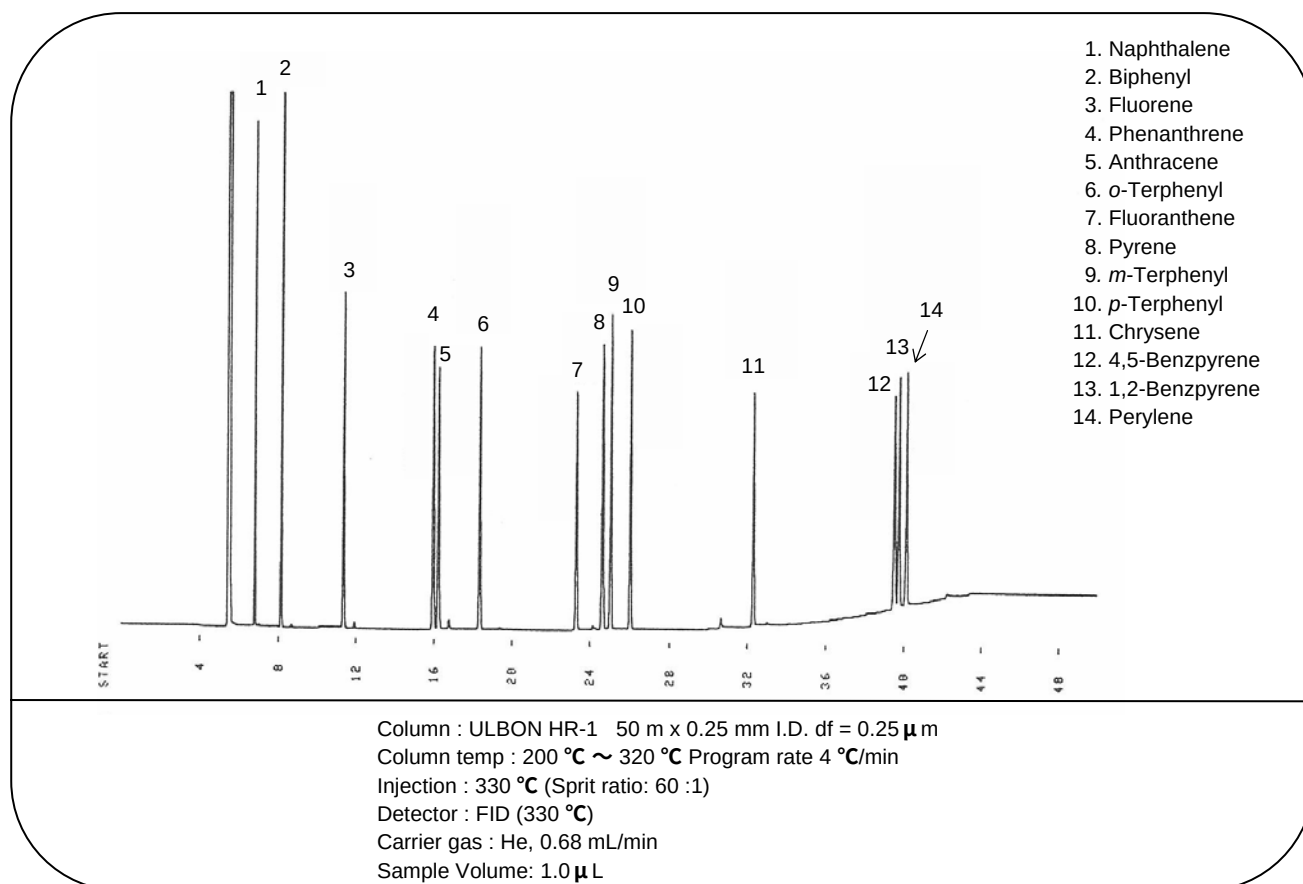
Premium gasoline



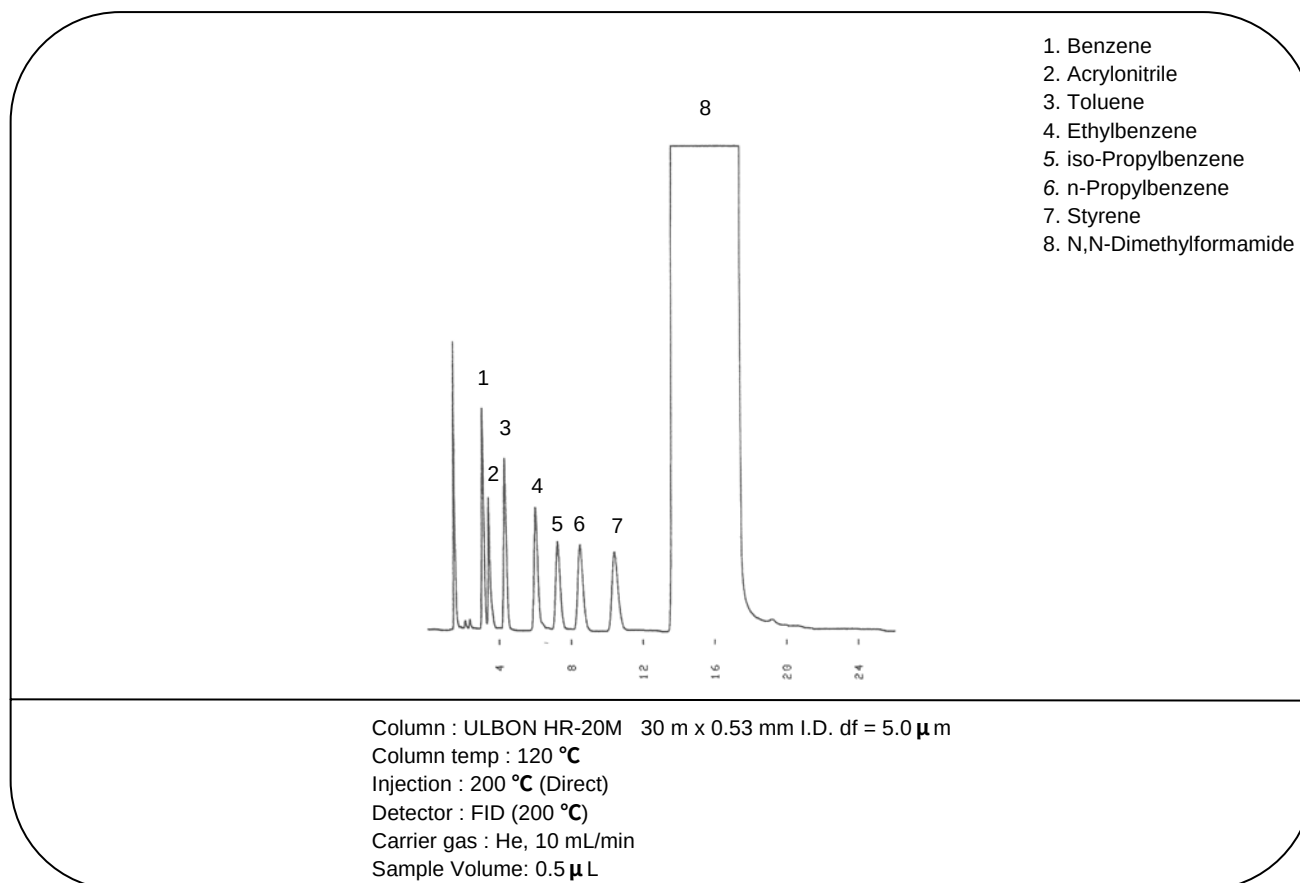
Aromatic hydrocarbons in Premium gasoline



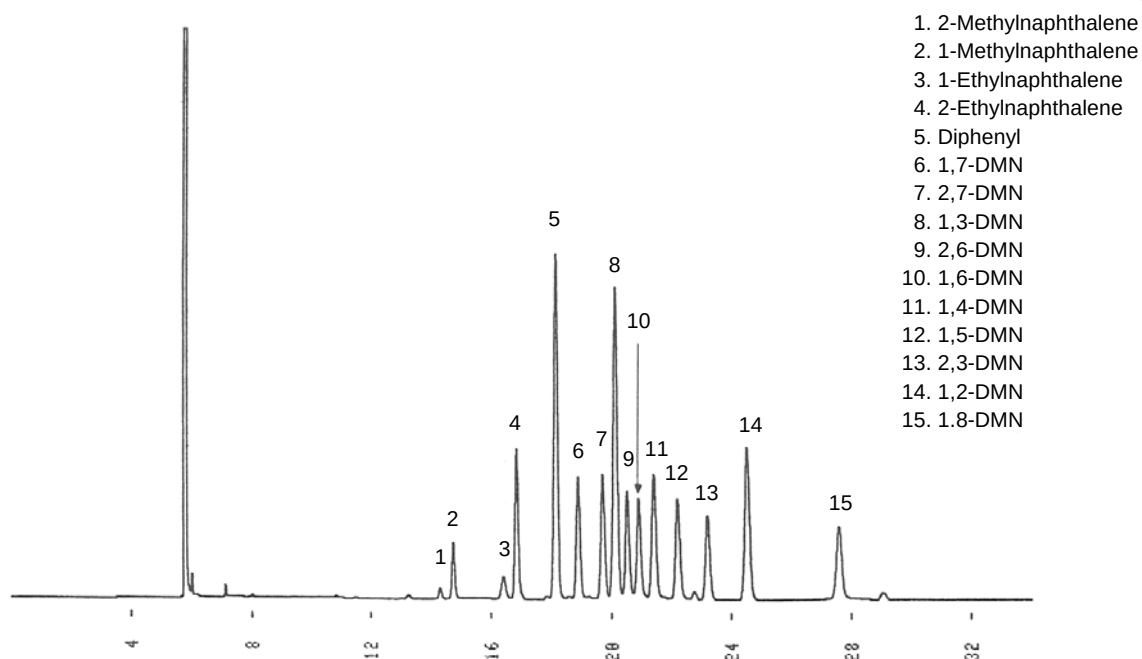
Polycyclic aromatic hydrocarbons



Styrene monomer (10ppm) in DMF

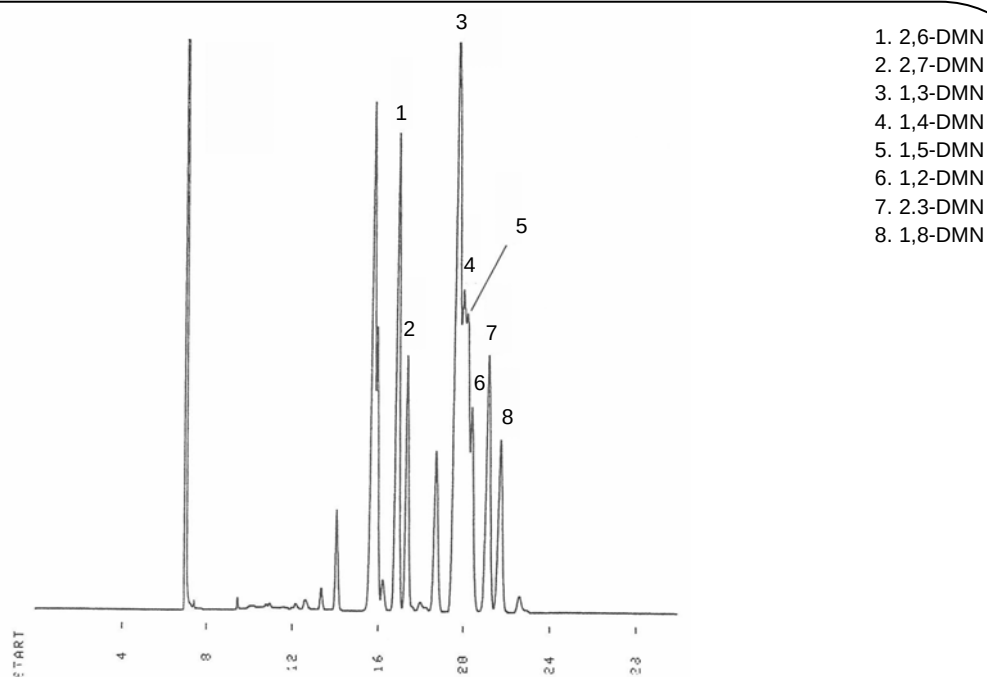


Dimethylnaphthalene (DMN) mixture



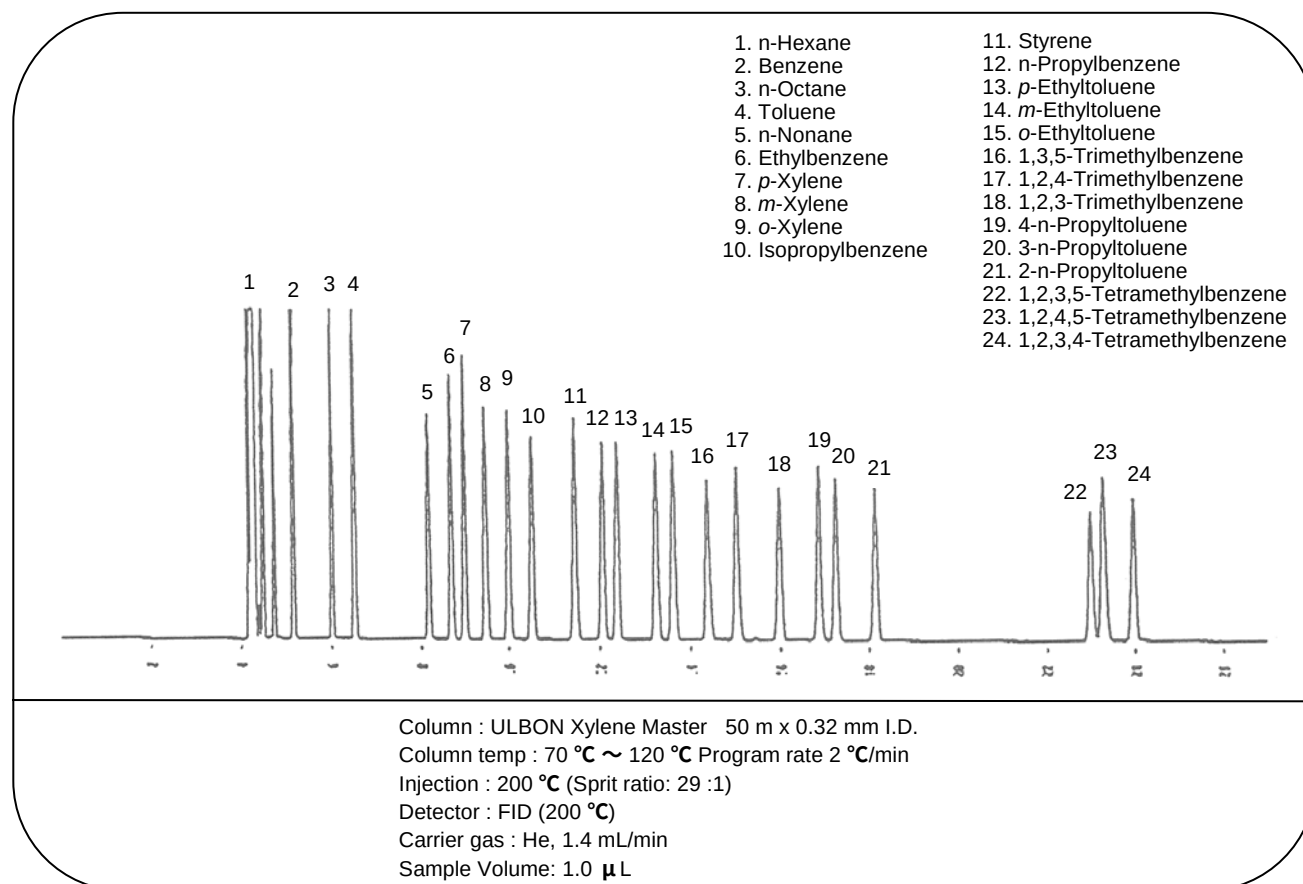
Column : ULBON PLC 50 m x 0.25 mm I.D.
 Column temp : 155 °C
 Injection : 200 °C (Sprit ratio: 70 :1)
 Detector : FID (200 °C)
 Carrier gas : N₂, 0.46 mL/min
 Sample Volume: 1.0 µL

2,6-, 2,7-Dimethylnaphthalene

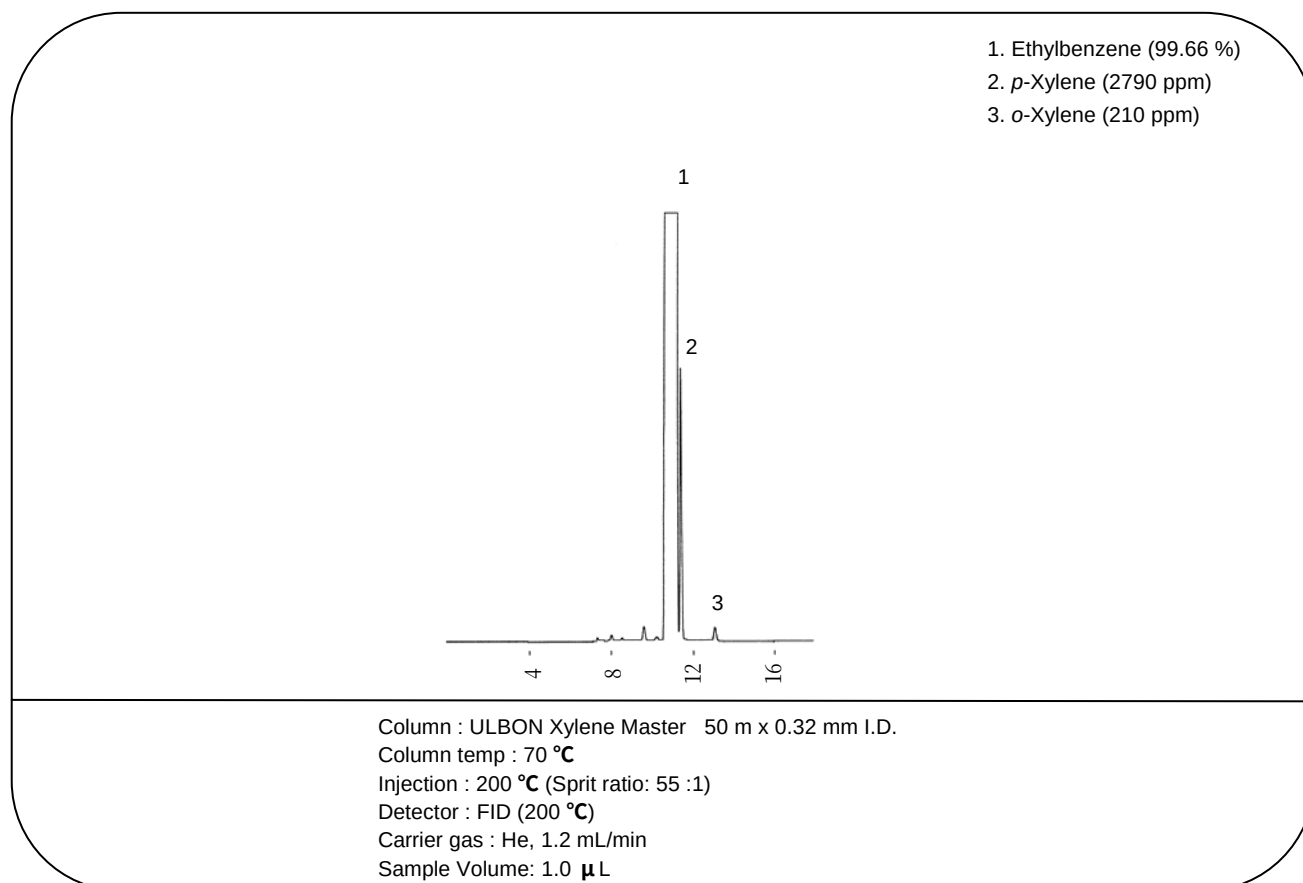


Column : ULBON DMN267 50 m x 0.20 mm I.D.
 Column temp : 160 °C
 Injection : 250 °C (Sprit ratio: 70 :1)
 Detector : FID (250 °C)
 Carrier gas : N₂, 0.42 mL/min
 Sample Volume: 1.0 µL

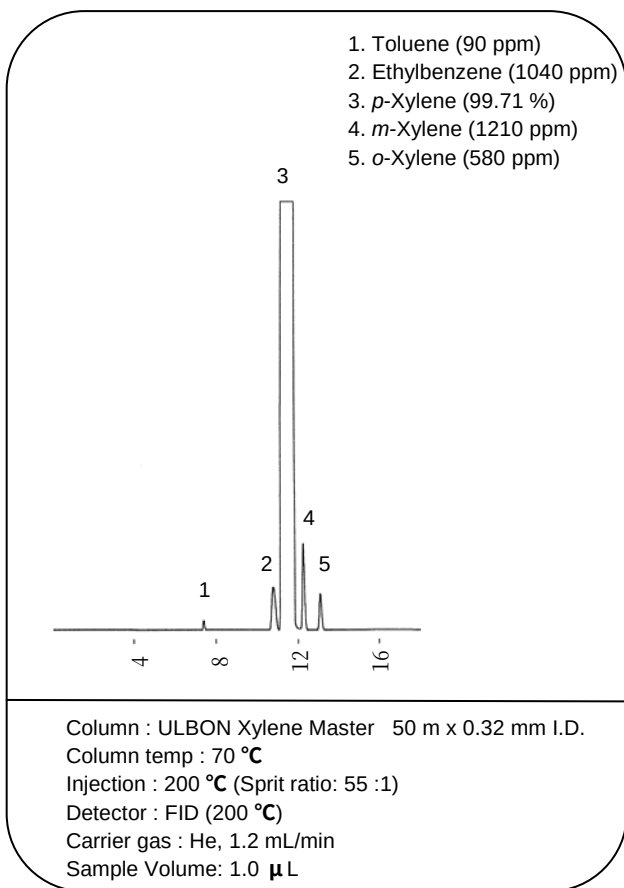
Alkyl benzene isomers



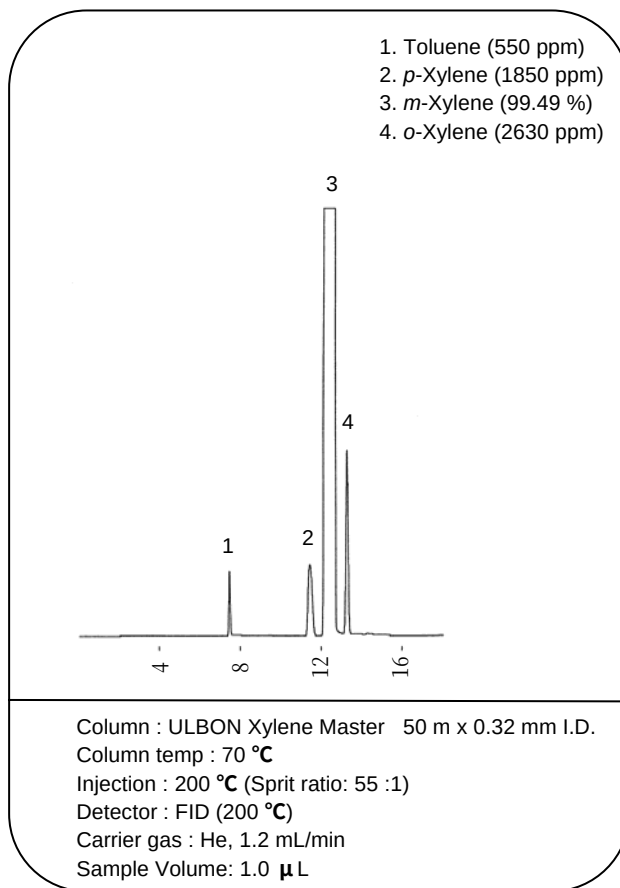
Ethylbenzene



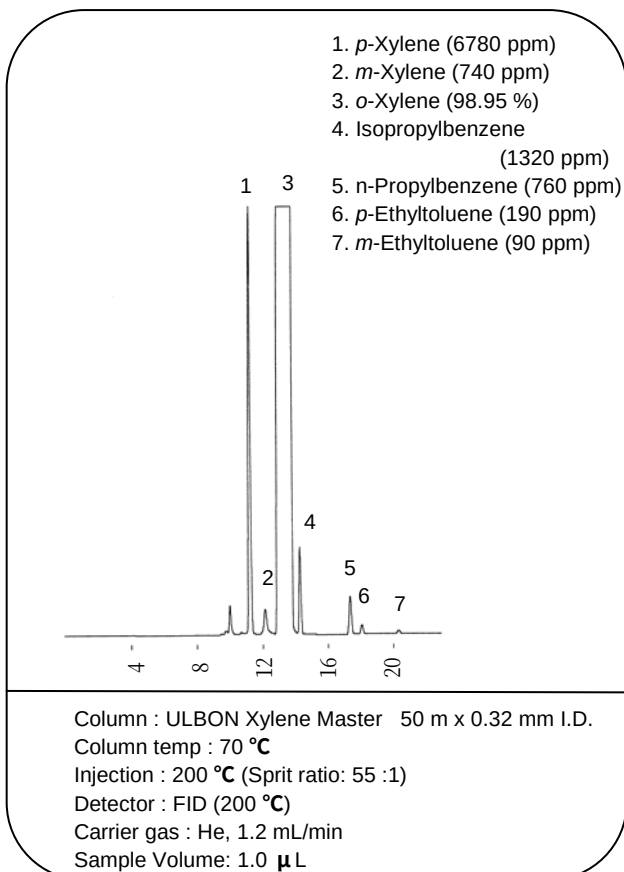
p-Xylene



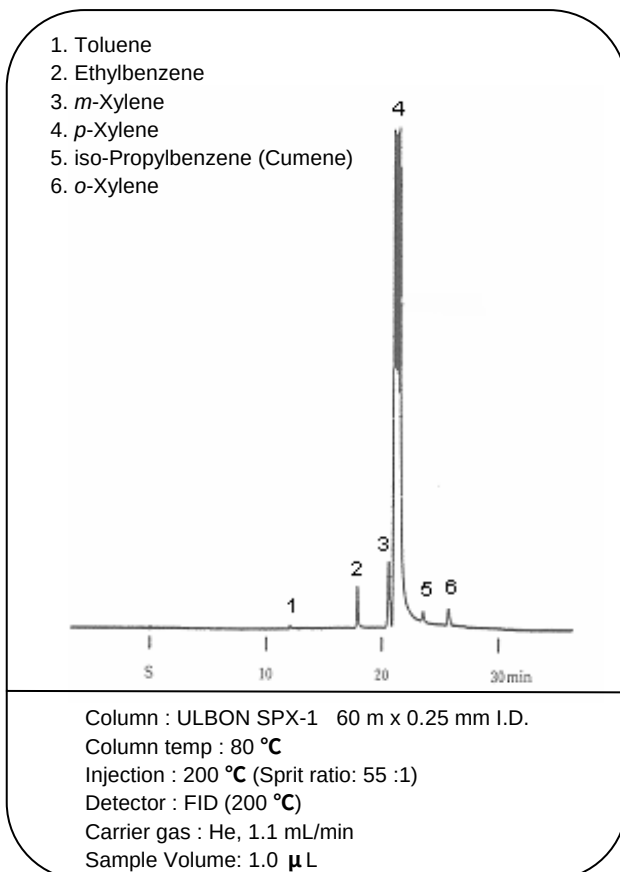
m-Xylene



o-Xylene

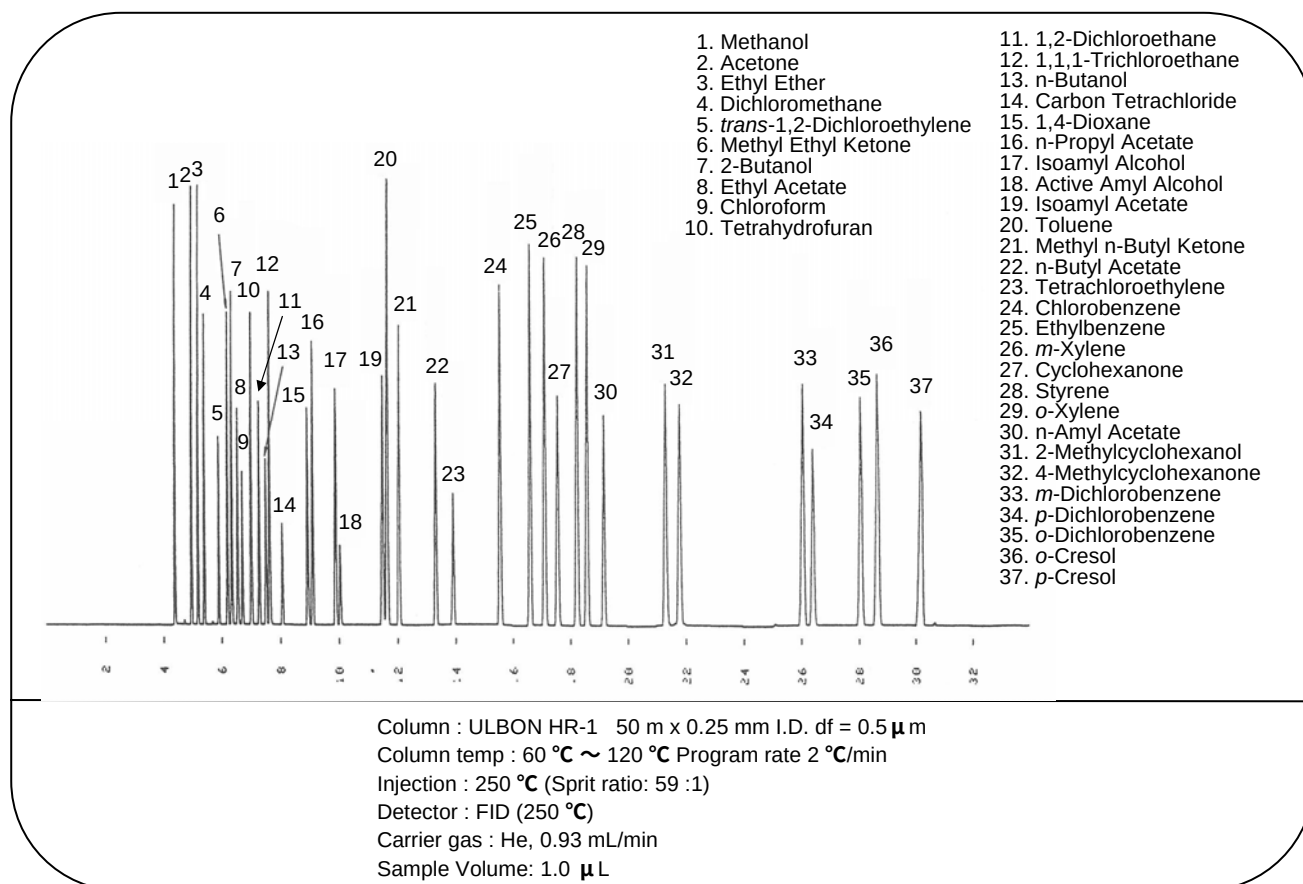


m-Xylene in *p*-Xylene

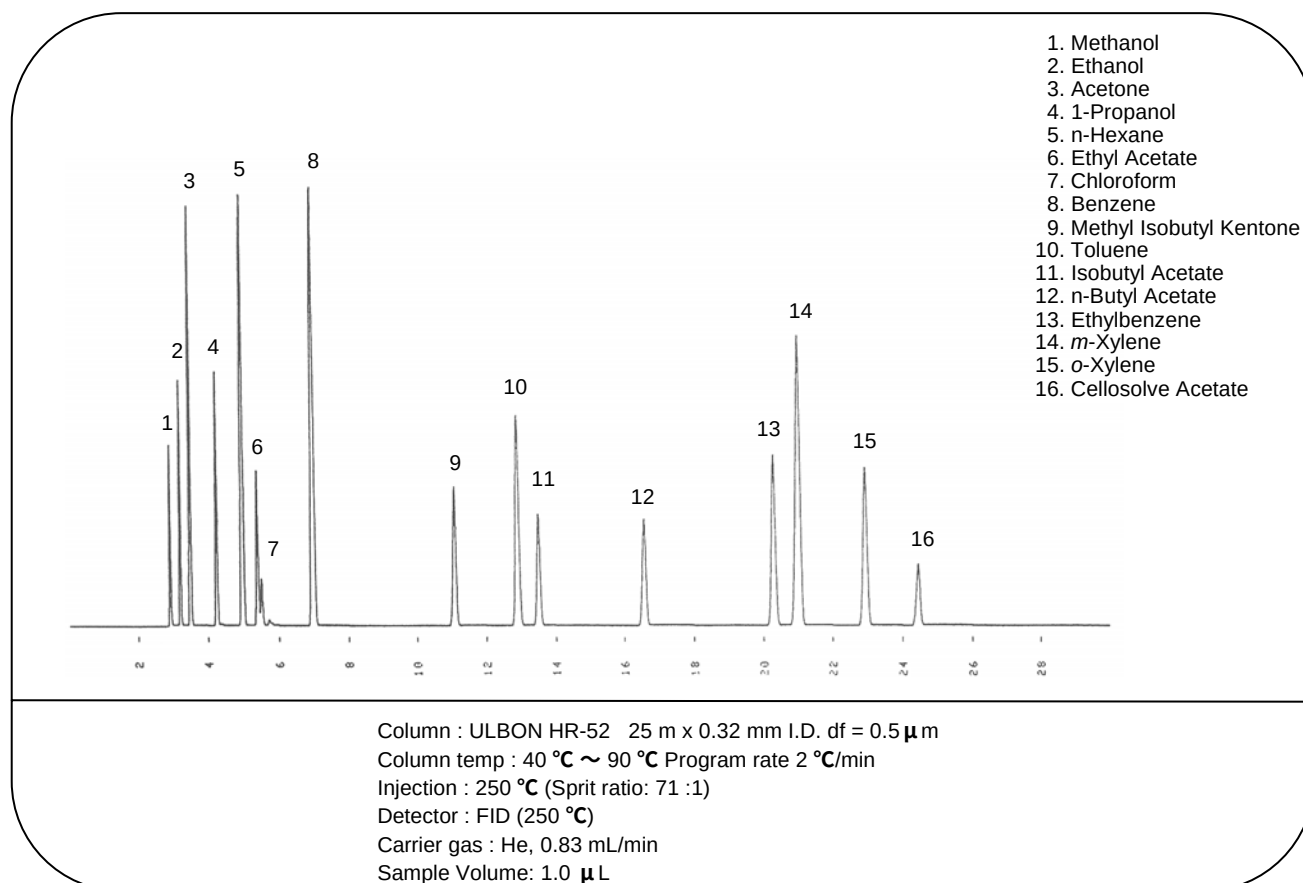


Organic Solvents

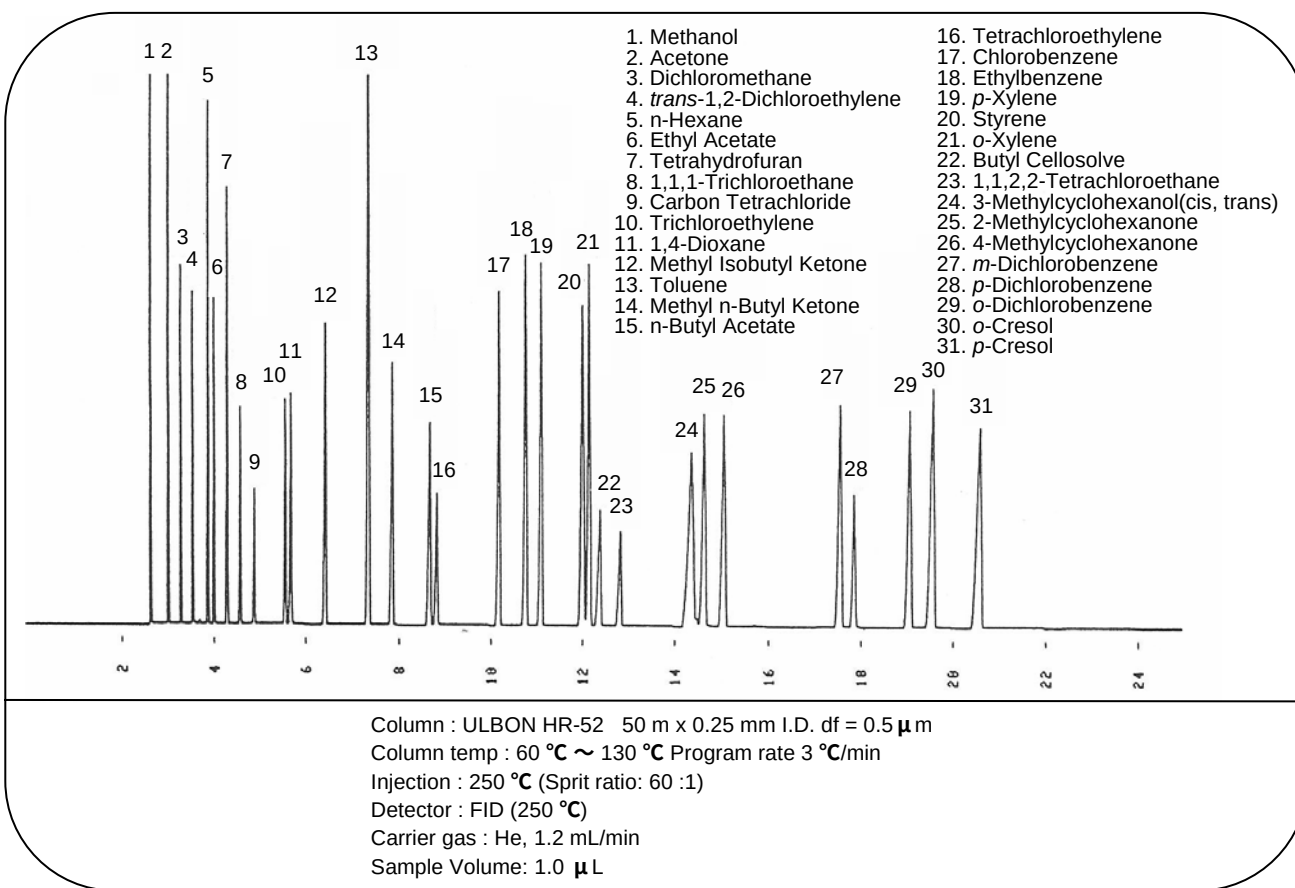
Solvents



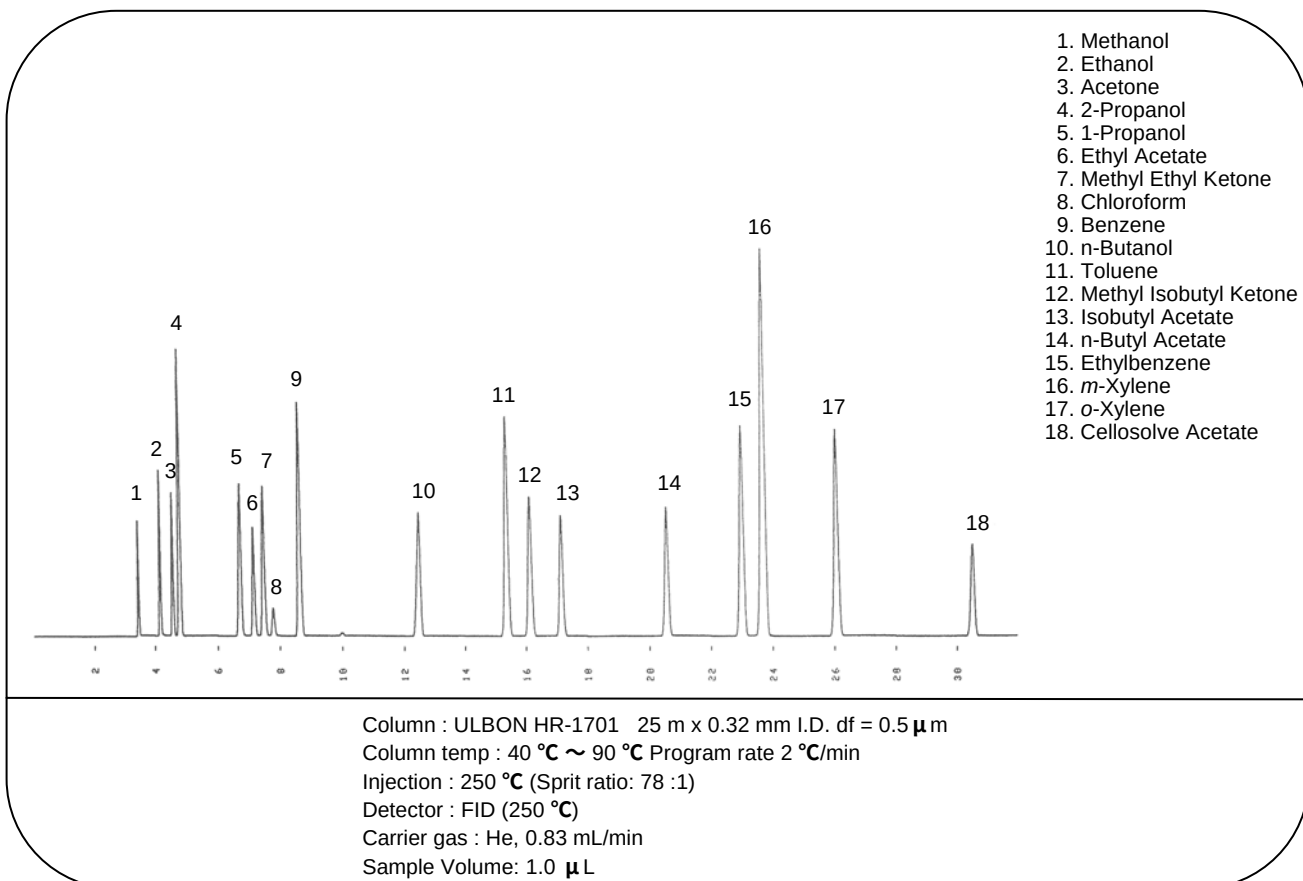
Solvents



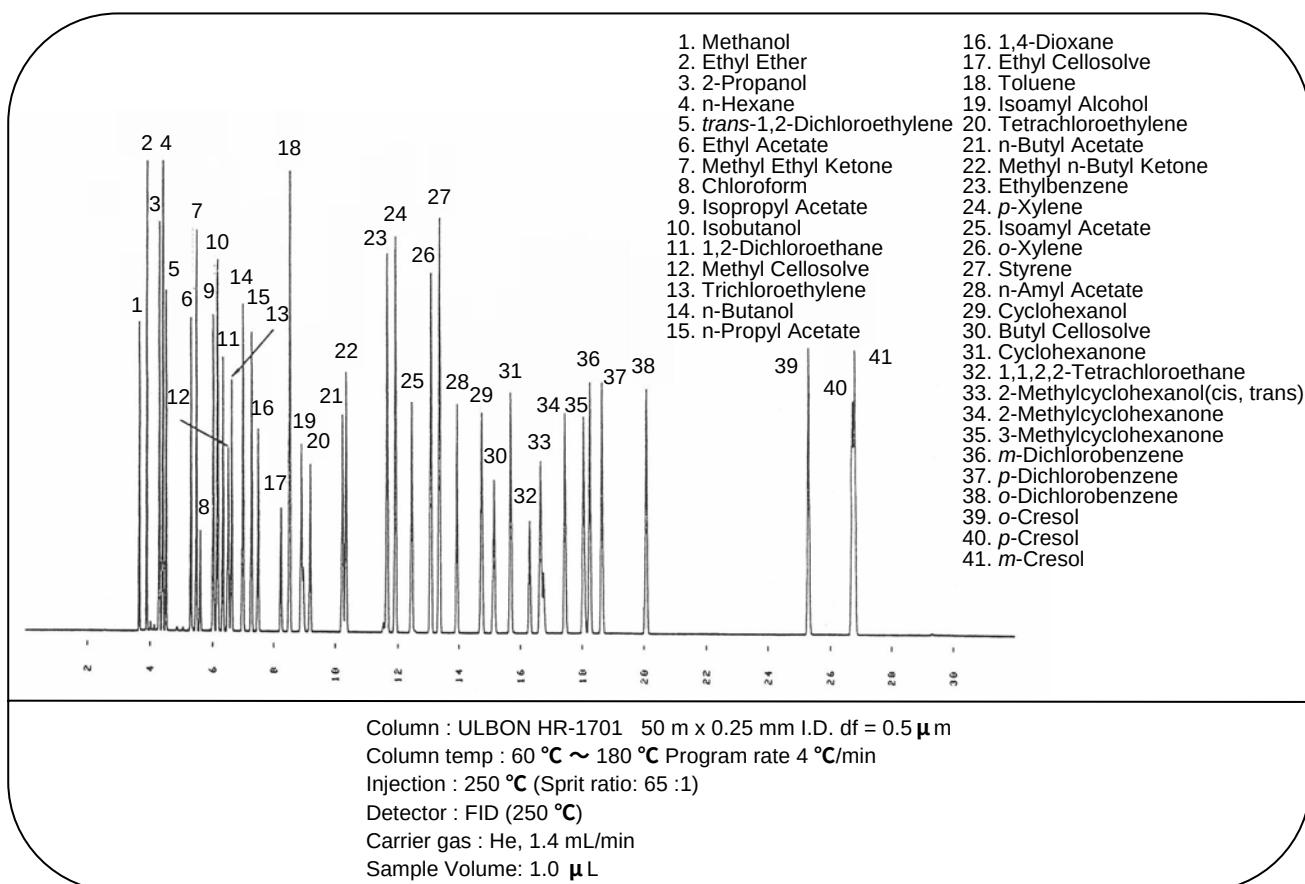
Solvents



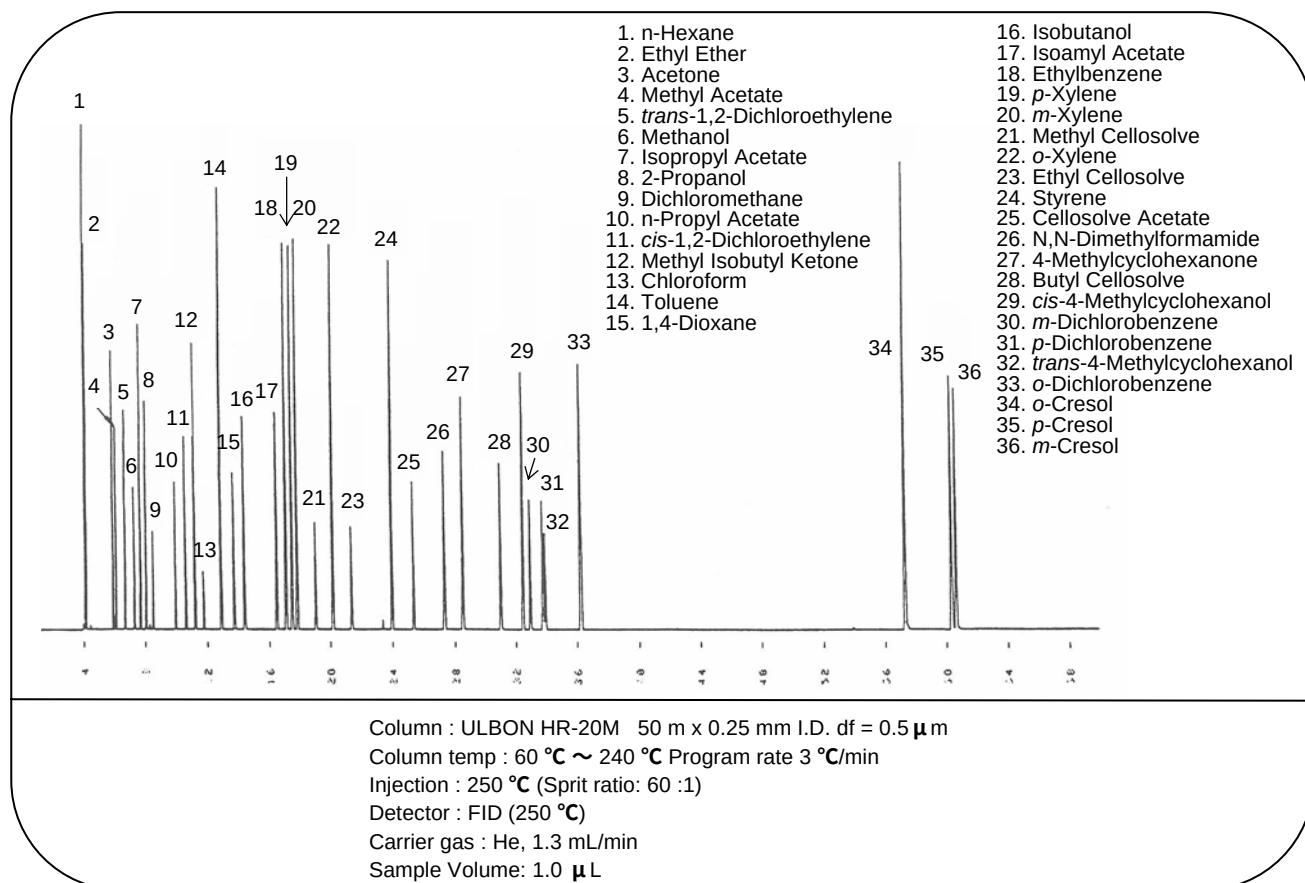
Solvents



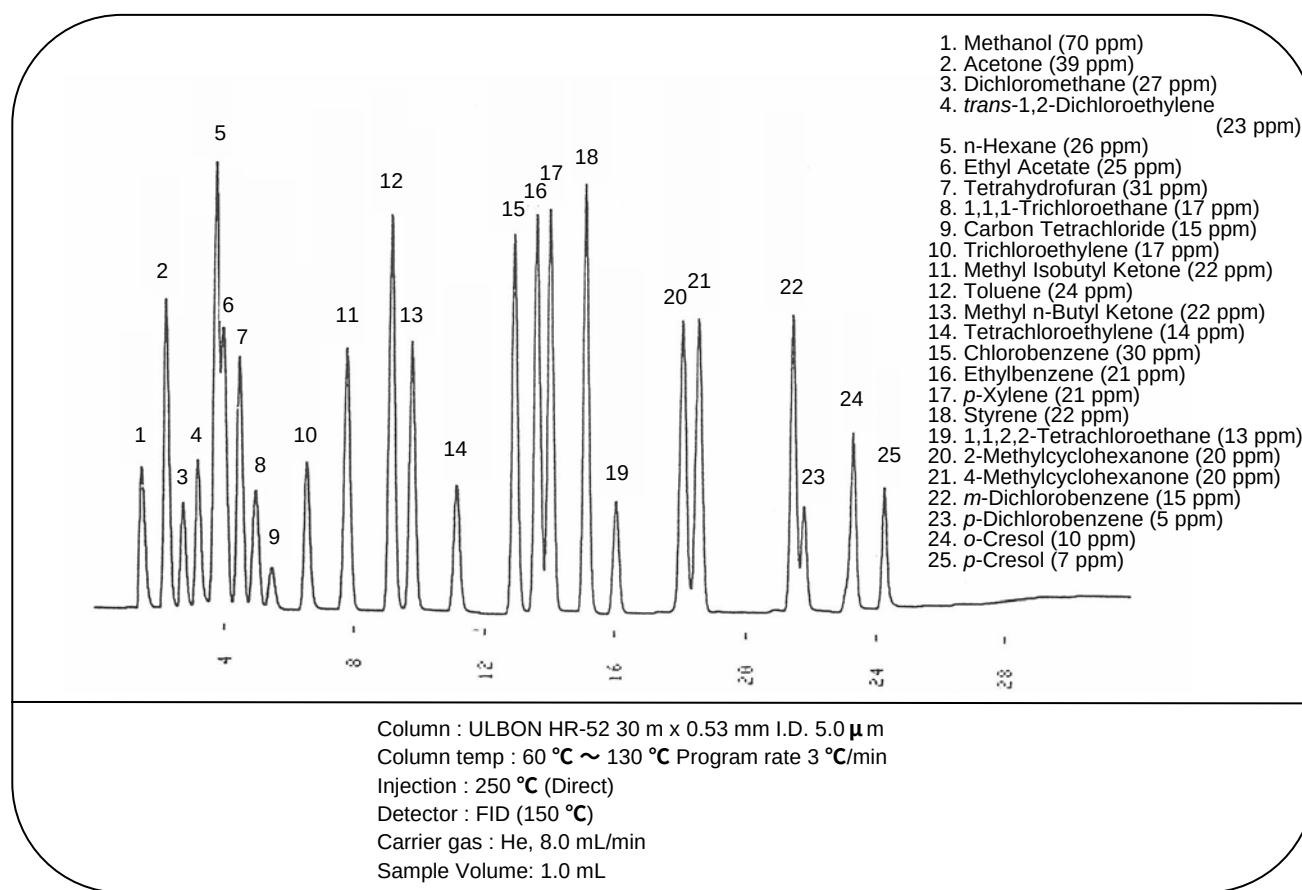
Solvents



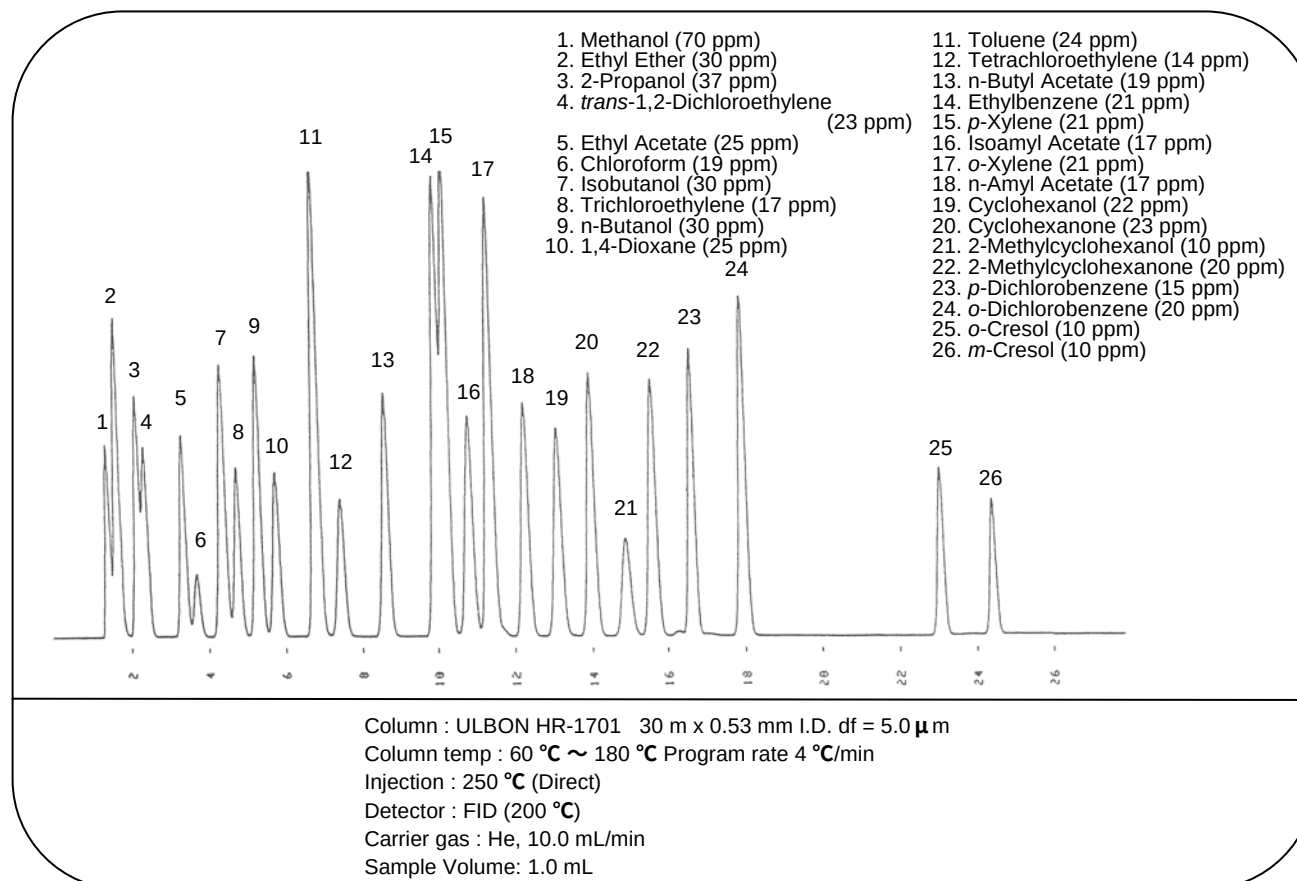
Solvents



The work environment

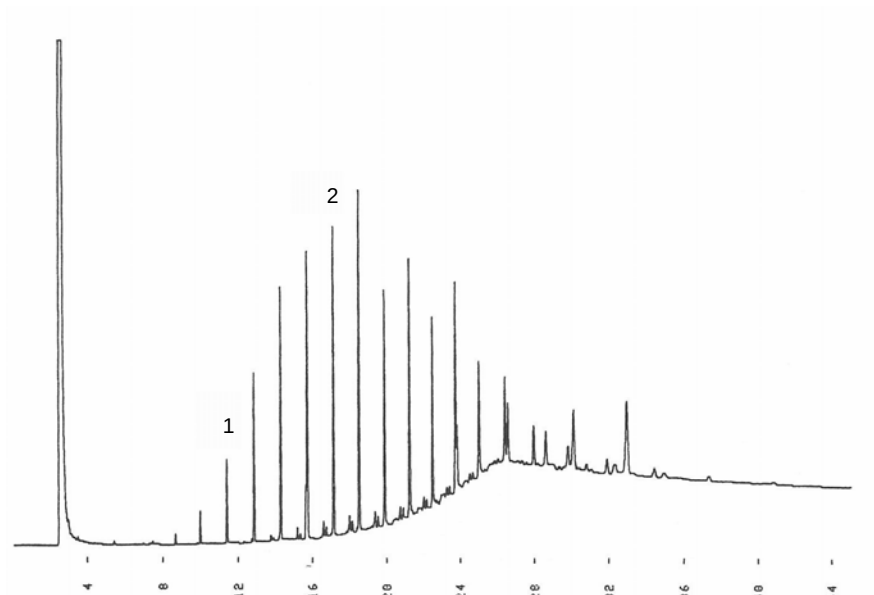


The work environment



Higher alcohols in Calnaubawax

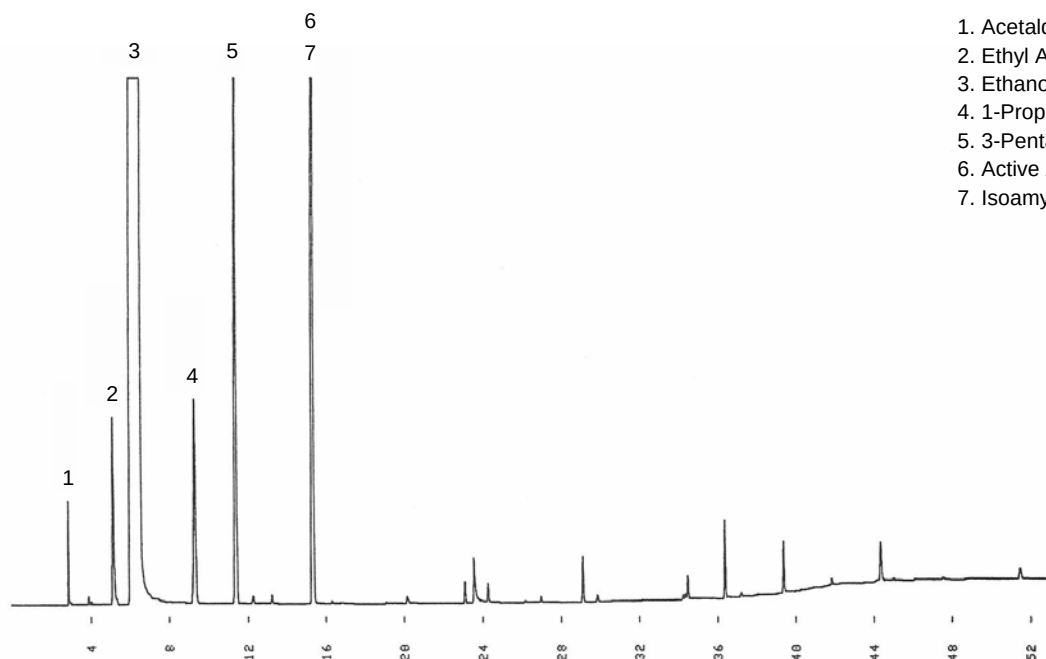
1. n-Octadecanol (C₁₈)
2. n-Docosanol (C₂₂)



Column : ULBON HR-52 25 m x 0.25 mm I.D. df = 0.25 μ m
 Column temp : 200 °C ~ 320 °C Program rate 5 °C/min
 Injection : 330 °C (Split ratio: 66 :1)
 Detector : FID (330 °C)
 Carrier gas : He, 0.5 mL/min
 Sample Volume: 1.2 μ L

Scotch whisky

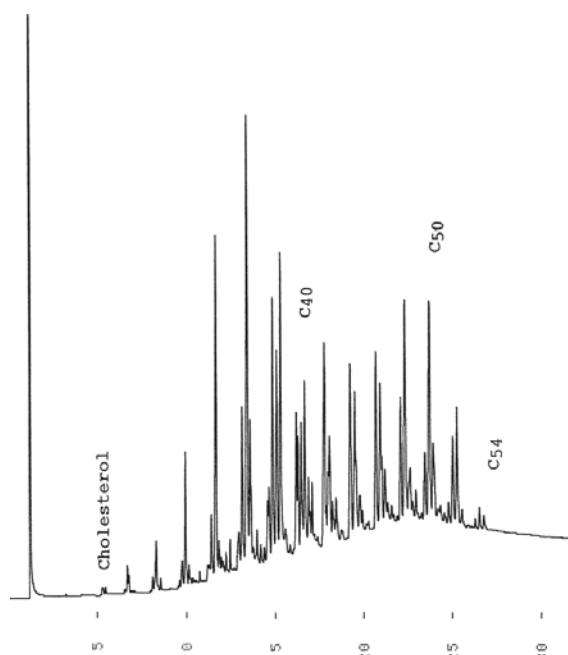
1. Acetaldehyde
2. Ethyl Acetate
3. Ethanol
4. 1-Propanol
5. 3-Pentanol
6. Active Amyl Alcohol
7. Isoamyl Alcohol



Column : ULBON HR-20M 50 m x 0.32 mm I.D. df = 1.0 μ m
 Column temp : 60 °C ~ 240 °C Program rate 5 °C/min
 Injection : 250 °C (Split ratio: 10 :1)
 Detector : FID (250 °C)
 Carrier gas : He, 4.0 mL/min
 Sample Volume: 0.6 μ L

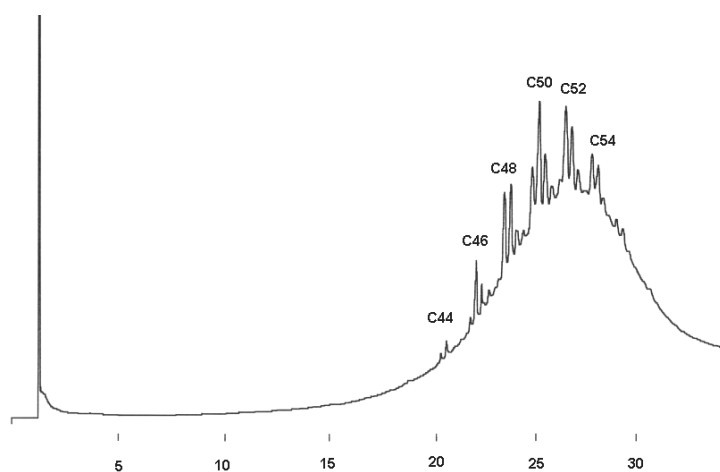
Triglyceride

Butter



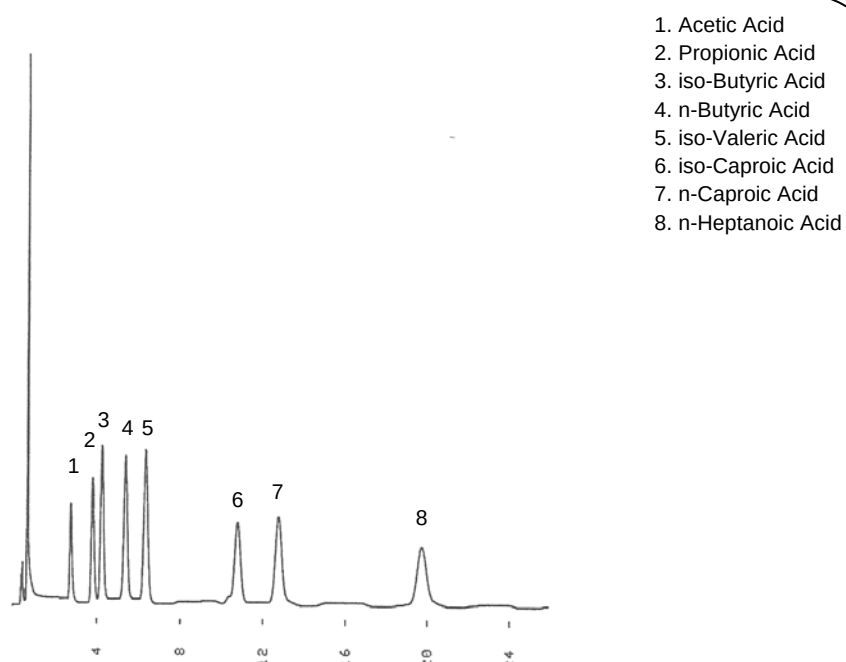
Column : ULBON HR-TGC-1 30 m x 0.25 mm I.D.
Column temp : 250 °C ~ 380 °C Program rate 5 °C/min
Injection : 380 °C (Split ratio: 45 :1)
Detector : FID (380 °C)
Carrier gas : He, 1.5 mL/min
Sample Volume: 1.0 µL

Salmon oil



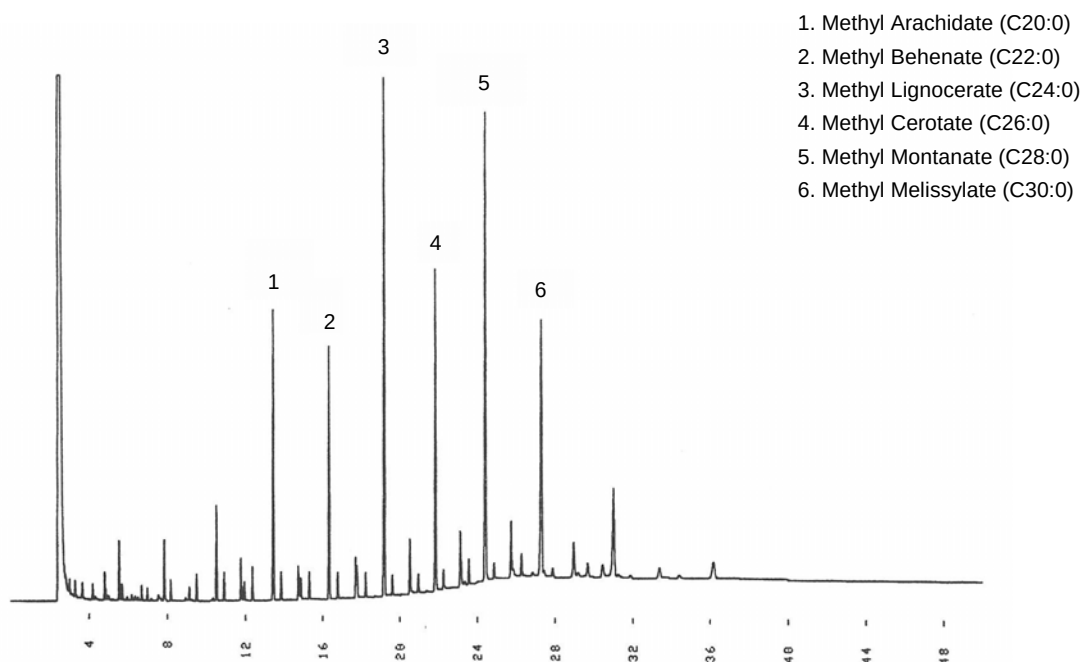
Column : ULBON HR-TGC-1 30 m x 0.25 mm I.D.
Column temp : 25 °C ~ 380 °C Program rate 5 °C/min
Injection : 380 °C (Split ratio: 45 :1)
Detector : FID (380 °C)
Carrier gas : He, 1.5 mL/min
Sample Volume: 1.0 µL

Lower fatty acids in water



Column : ULBON HR-20M 30 m x 0.53 mm I.D. df = 3.0 μ m
 Column temp : 150 $^{\circ}$ C
 Injection : 250 $^{\circ}$ C (Direct)
 Detector : FID (250 $^{\circ}$ C)
 Carrier gas : He, 10.5 mL/min
 Sample Volume: 0.4 μ L

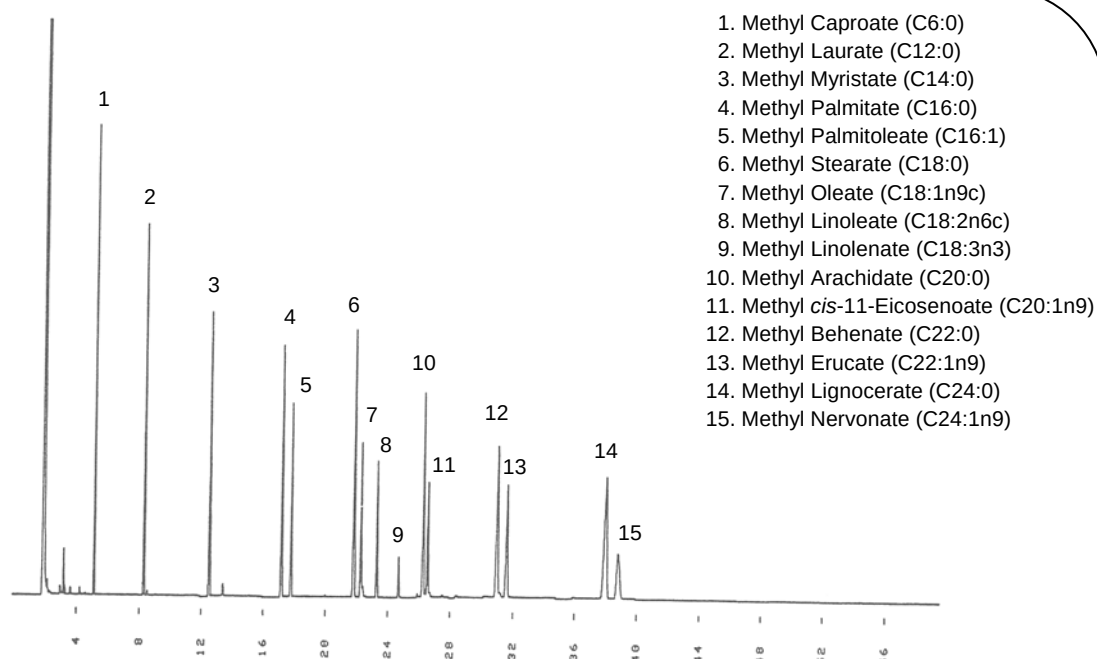
Higher fatty acid esters in Calnaubawax



Column : ULBON HR-52 25 m x 0.25 mm I.D. 0.25 μ m
 Column temp : 200 $^{\circ}$ C ~ 320 $^{\circ}$ C Program rate 5 $^{\circ}$ C/min
 Injection : 330 $^{\circ}$ C (Split ratio: 61 :1)
 Detector : FID (330 $^{\circ}$ C)
 Carrier gas : He, 0.5 mL/min
 Sample Volume: 1.0 μ L

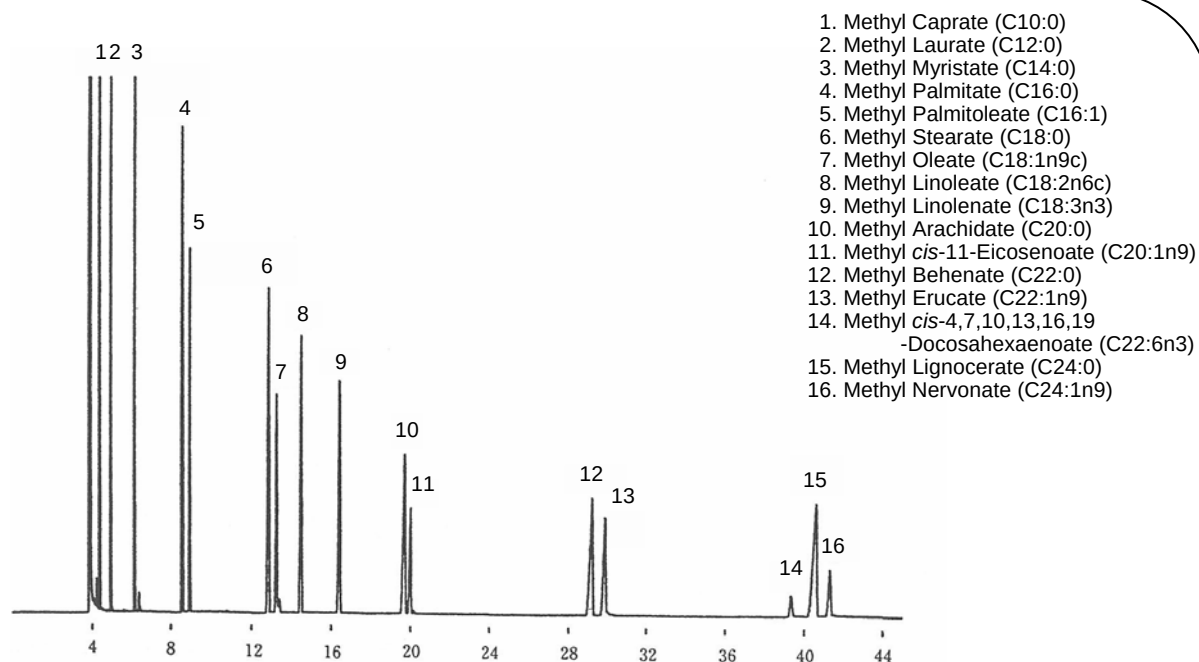
Fatty Acids and Esters

Fatty acid methyl esters



Column : ULBON HR-20M 25 m x 0.25 mm I.D. df = 0.25 μ m
 Column temp : 130 $^{\circ}$ C ~ 240 $^{\circ}$ C Program rate 4 $^{\circ}$ C/min
 Injection : 250 $^{\circ}$ C (Split ratio: 40 :1)
 Detector : FID (250 $^{\circ}$ C)
 Carrier gas : He, 1.1 mL/min
 Sample Volume: 1.0 μ L

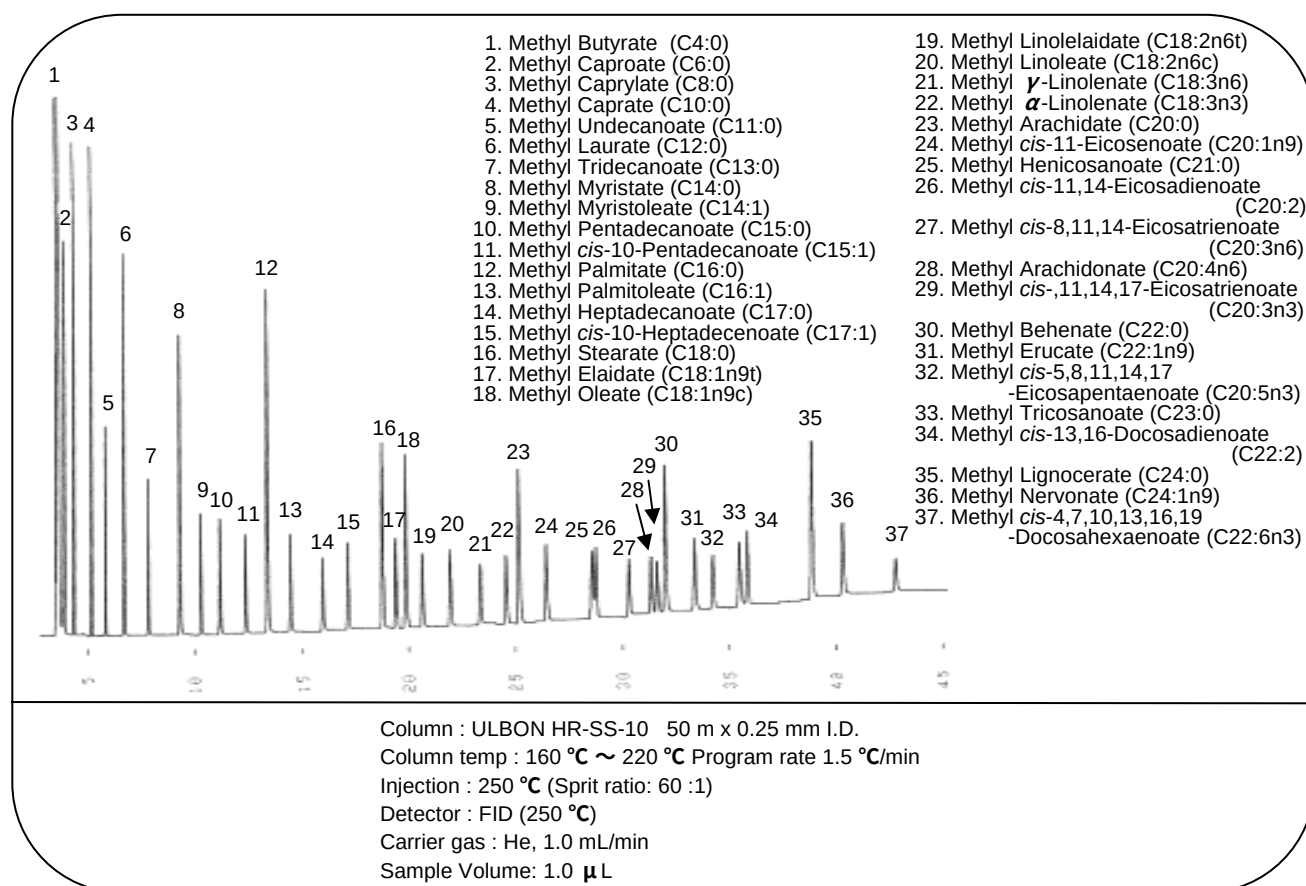
Fatty acid methyl esters standard



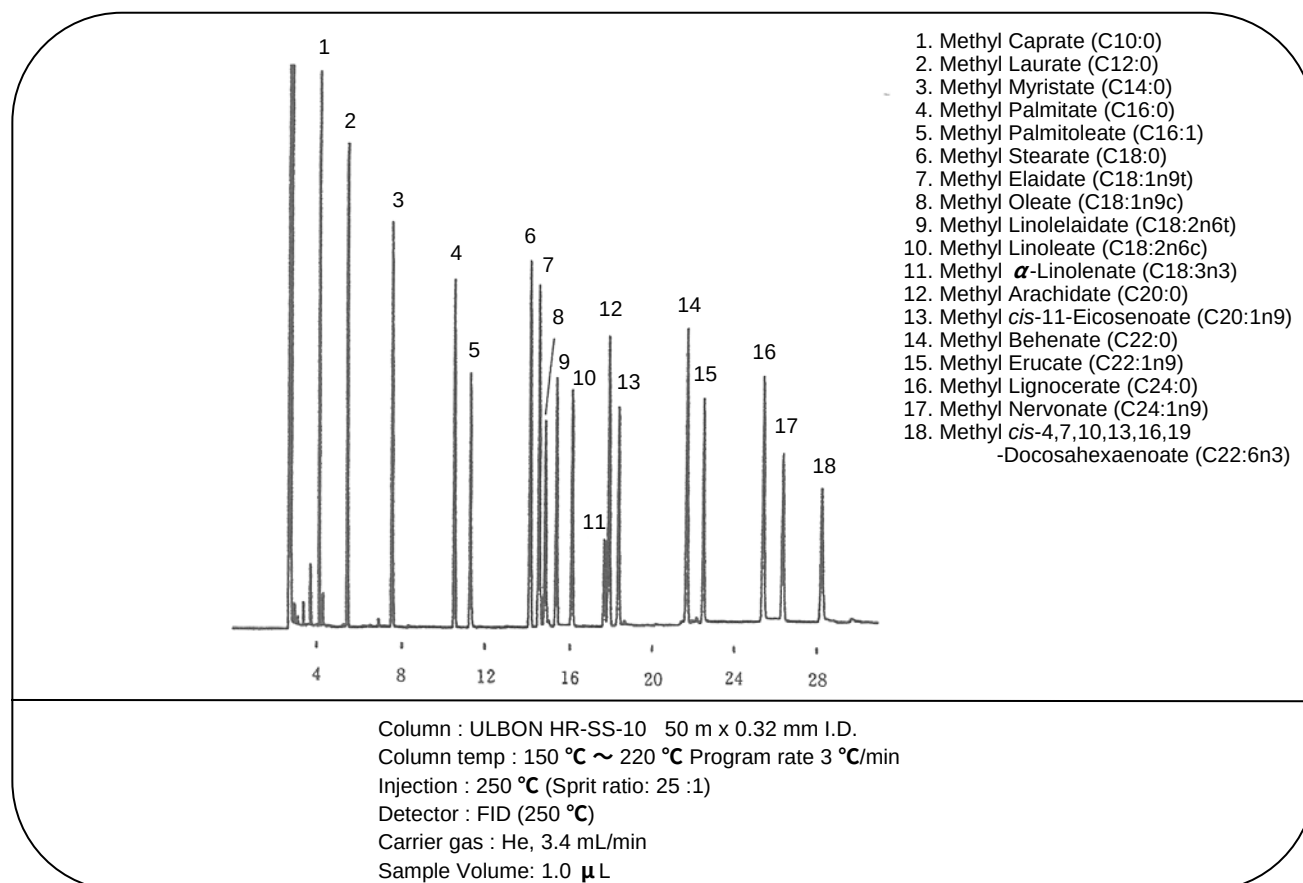
Column : ULBON HR-Thermon-3000B 50 m x 0.25 mm I.D.
 Column temp : 180 $^{\circ}$ C ~ 220 $^{\circ}$ C Program rate 1 $^{\circ}$ C/min
 Injection : 250 $^{\circ}$ C (Split ratio: 50 :1)
 Detector : FID (250 $^{\circ}$ C)
 Carrier gas : He, 1.7 mL/min
 Sample Volume: 1.0 μ L

Fatty Acids and Esters

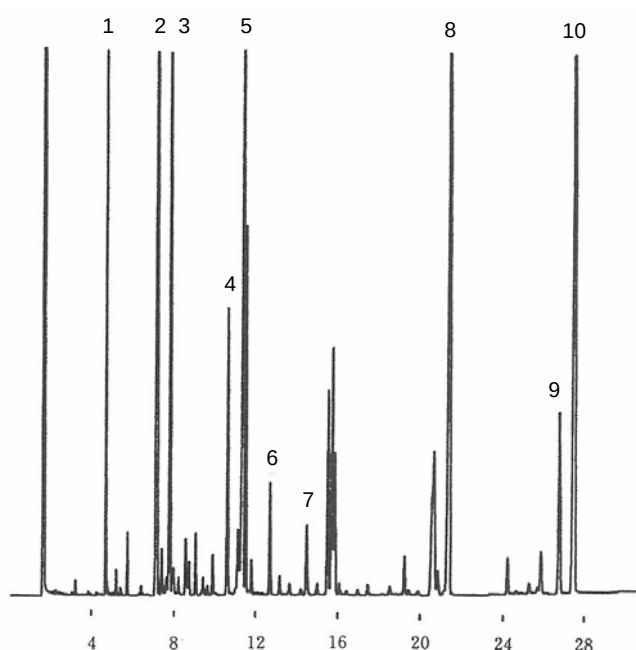
Fatty acid methyl esters standard



Fatty acid methyl esters standard



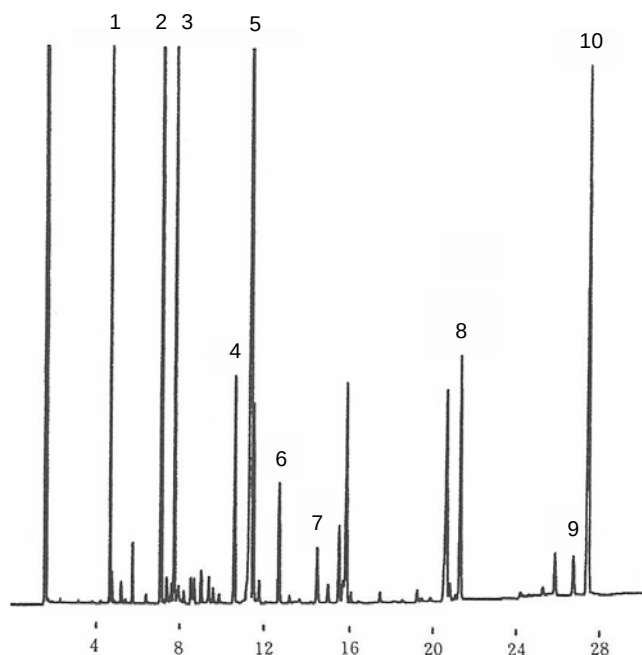
Young yellowtail oil



1. Methyl Myristate (C14:0)
2. Methyl Palmitate (C16:0)
3. Methyl Palmitoleate (C16:1)
4. Methyl Stearate (C18:0)
5. Methyl Oleate (C18:1n9c)
6. Methyl Linoleate (C18:2n6c)
7. Methyl α -Linolenate (C18:3n3)
8. Methyl *cis*-5,8,11,14,17-Eicosapentaenoate (C20:5n3)
9. Methyl *cis*-7,10,13,16,19-Docosapentaenoate (C22:5n3)
10. Methyl *cis*-4,7,10,13,16,19-Docosahexaenoate (C22:6n3)

Column : ULBON HR-SS-10 25 m x 0.25 mm I.D.
 Column temp : 150 °C ~ 220 °C Program rate 2 °C/min
 Injection : 250 °C (Split ratio: 60 :1)
 Detector : FID (250 °C)
 Carrier gas : He, 1.5 mL/min
 Sample Volume: 1.0 μ L

Tuna oil

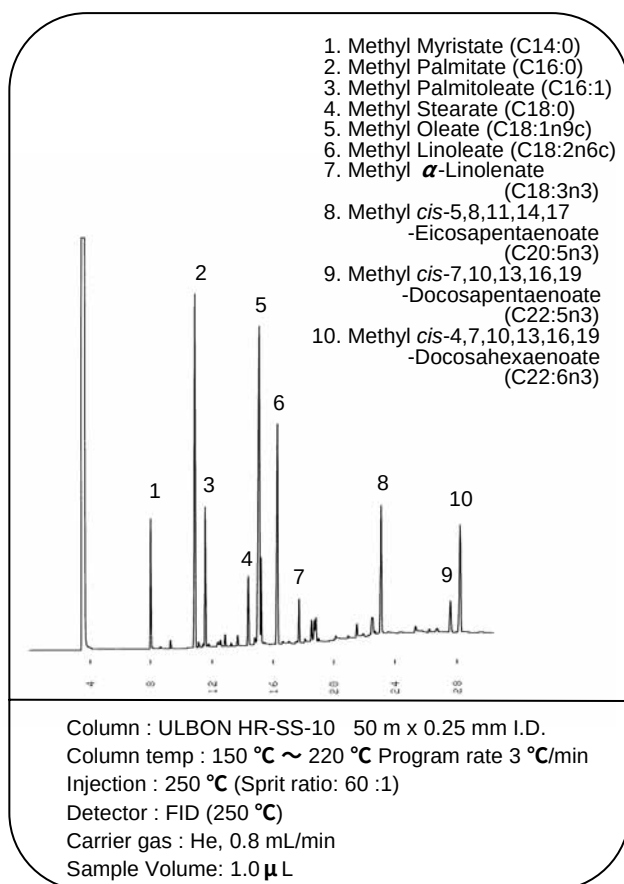


1. Methyl Myristate (C14:0)
2. Methyl Palmitate (C16:0)
3. Methyl Palmitoleate (C16:1)
4. Methyl Stearate (C18:0)
5. Methyl Oleate (C18:1n9c)
6. Methyl Linoleate (C18:2n6c)
7. Methyl α -Linolenate (C18:3n3)
8. Methyl *cis*-5,8,11,14,17-Eicosapentaenoate (C20:5n3)
9. Methyl *cis*-7,10,13,16,19-Docosapentaenoate (C22:5n3)
10. Methyl *cis*-4,7,10,13,16,19-Docosahexaenoate (C22:6n3)

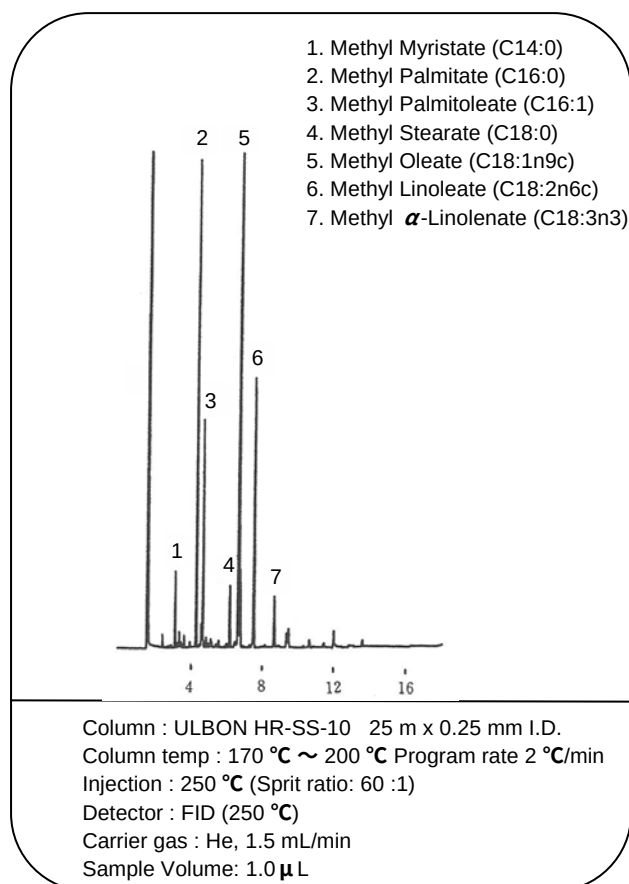
Column : ULBON HR-SS-10 25 m x 0.25 mm I.D.
 Column temp : 150 °C ~ 220 °C Program rate 2 °C/min
 Injection : 250 °C (Split ratio: 60 :1)
 Detector : FID (250 °C)
 Carrier gas : He, 1.5 mL/min
 Sample Volume: 1.0 μ L

Fatty Acids and Esters

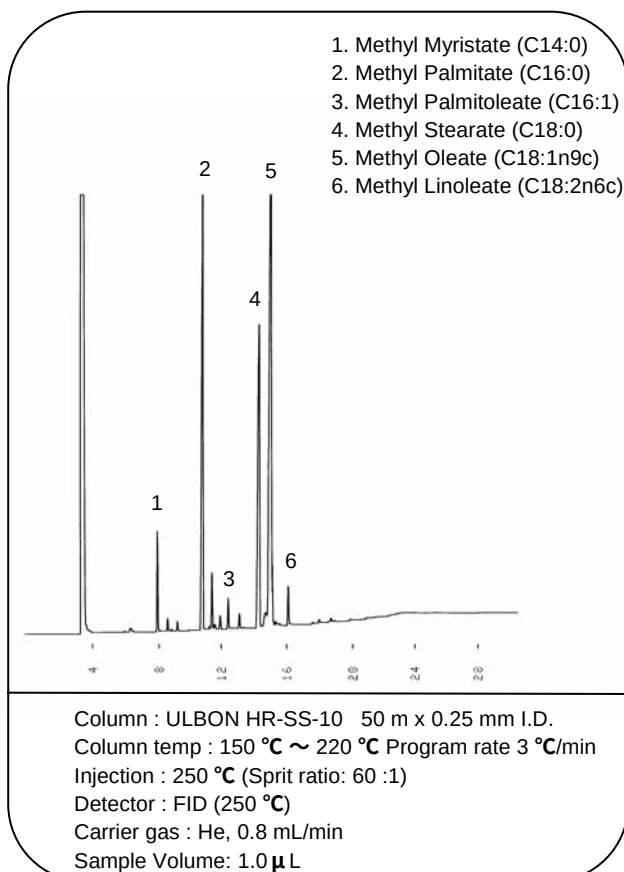
Yellowtail oil



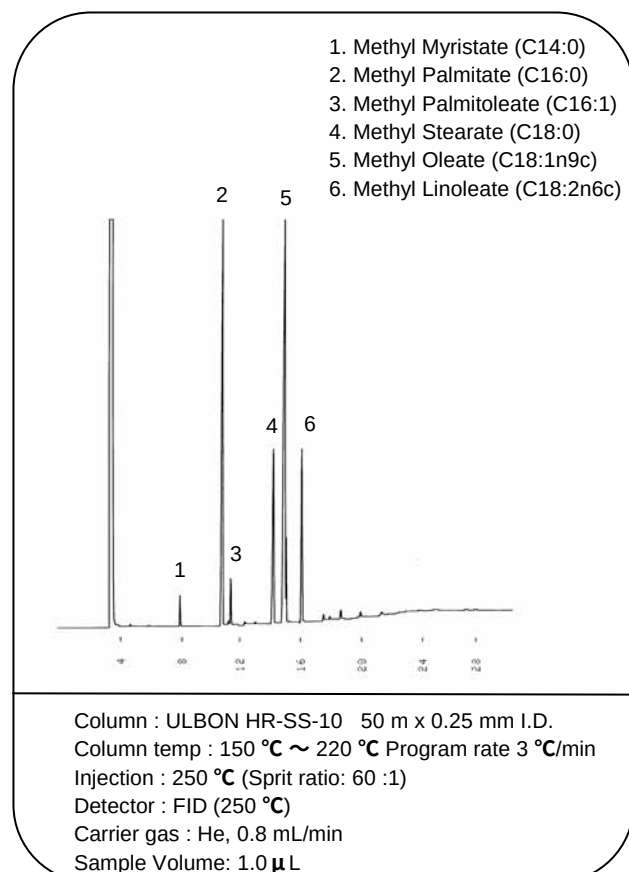
Carp oil



Beef tallow

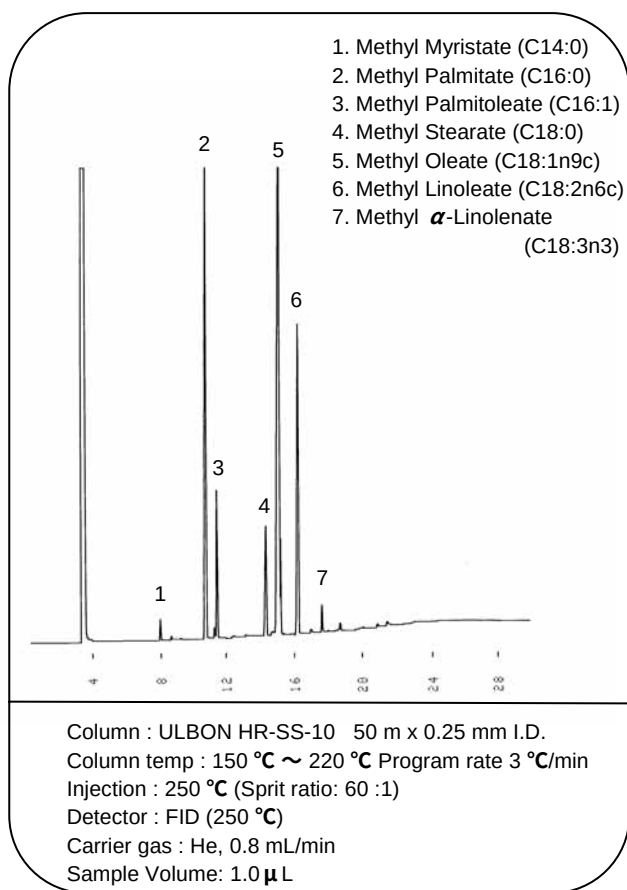


Lard

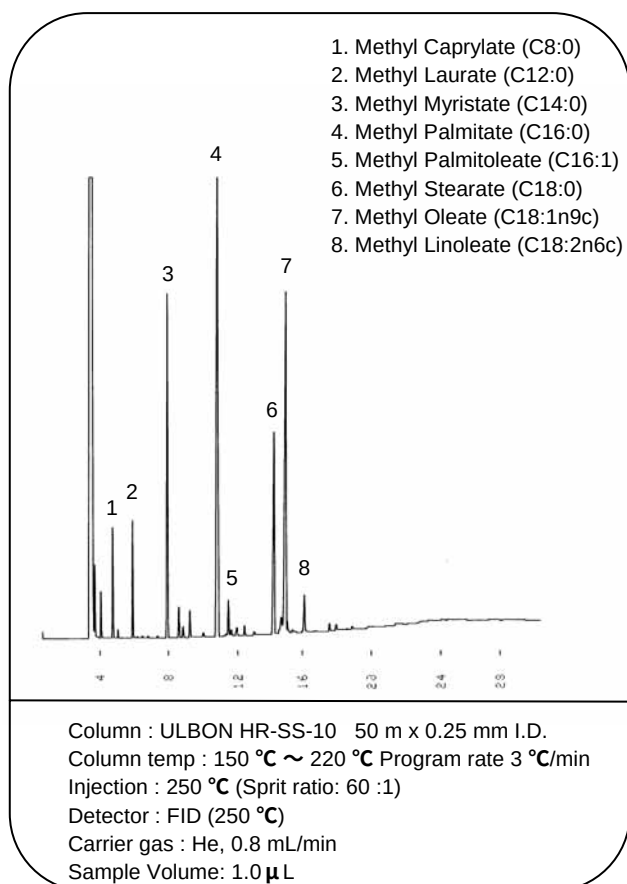


Fatty Acids and Esters

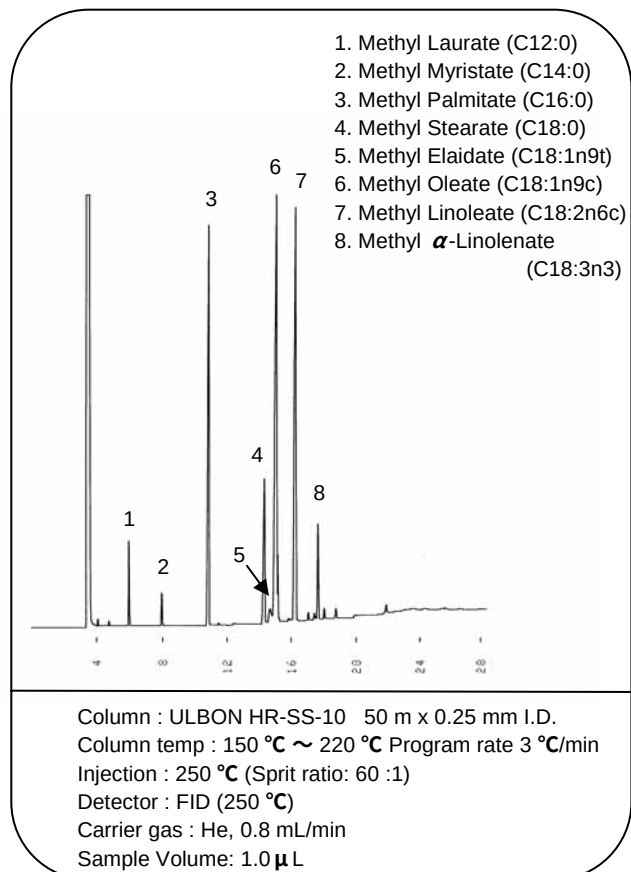
Chicken oil



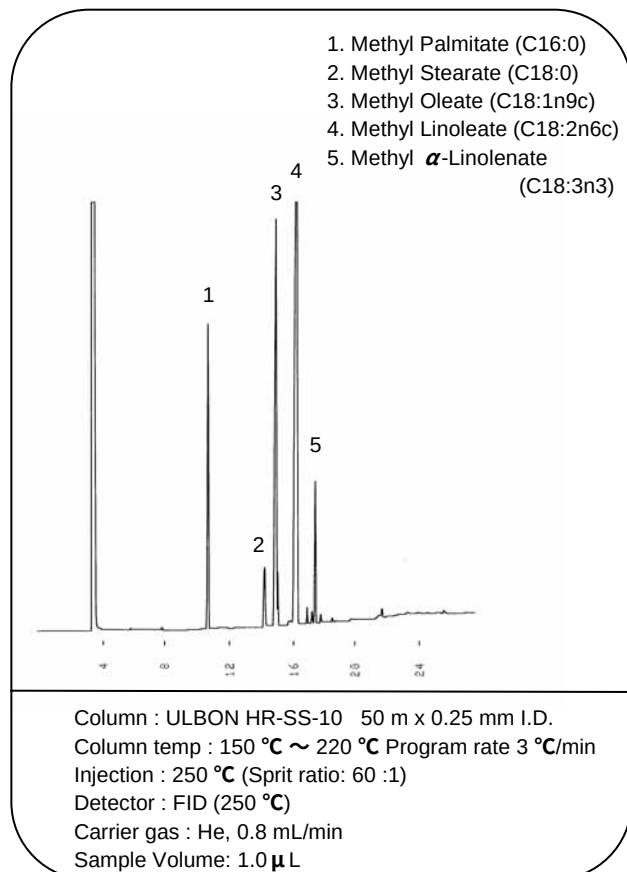
Butter



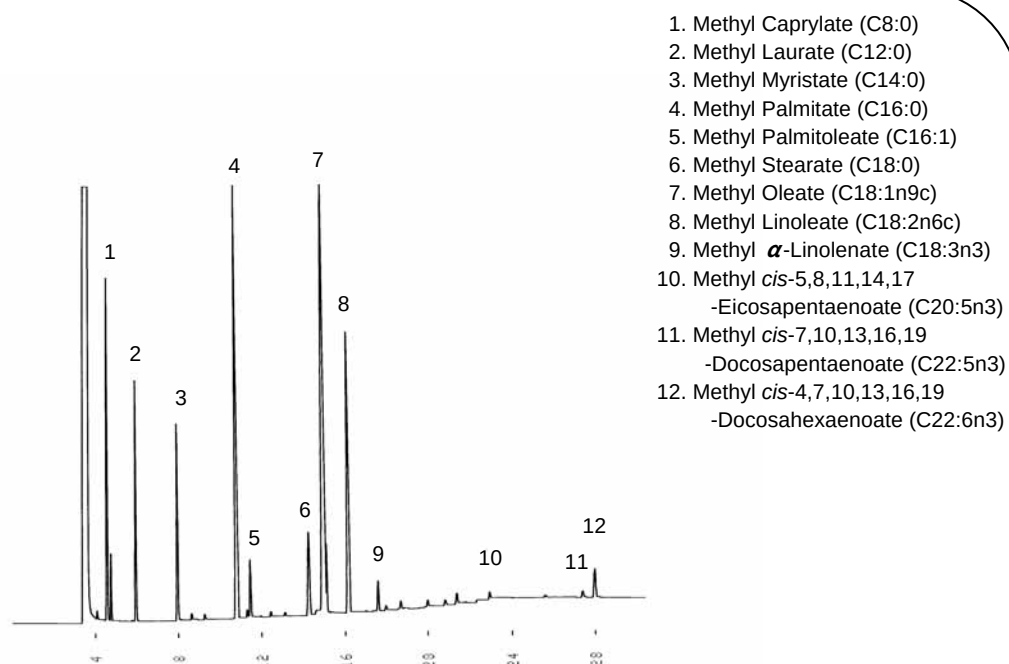
Margarine



Soybean

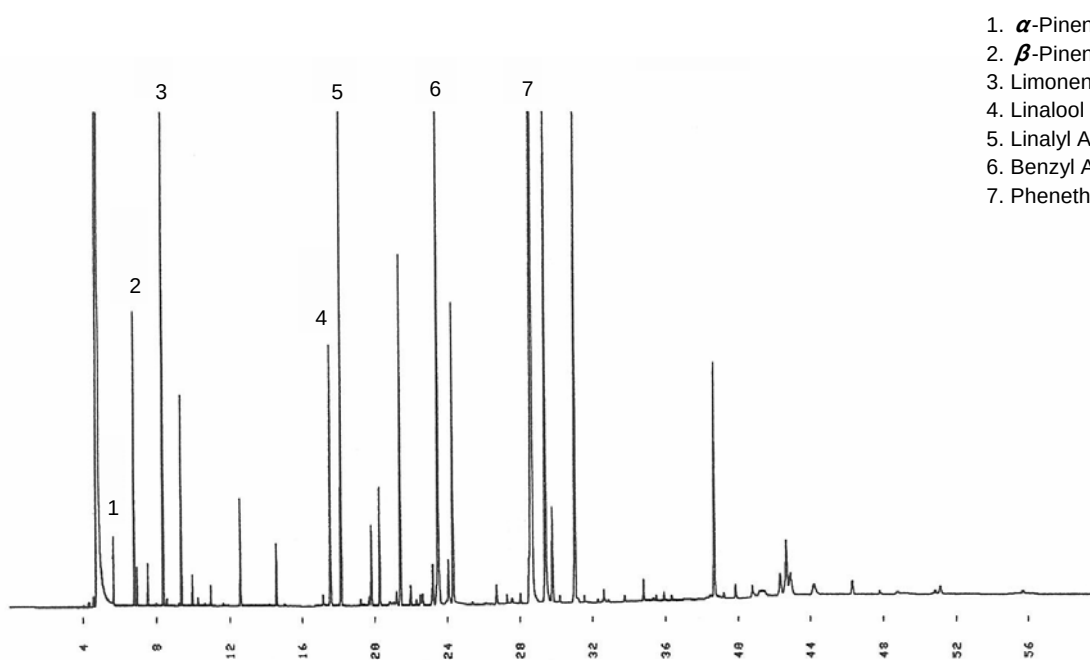


Breast milk



Column : ULBON HR-SS-10 50 m x 0.25 mm I.D.
 Column temp : 150 °C ~ 220 °C Program rate 3 °C/min
 Injection : 250 °C (Split ratio: 60 :1)
 Detector : FID (250 °C)
 Carrier gas : He, 0.8 mL/min
 Sample Volume: 1.0 μ L

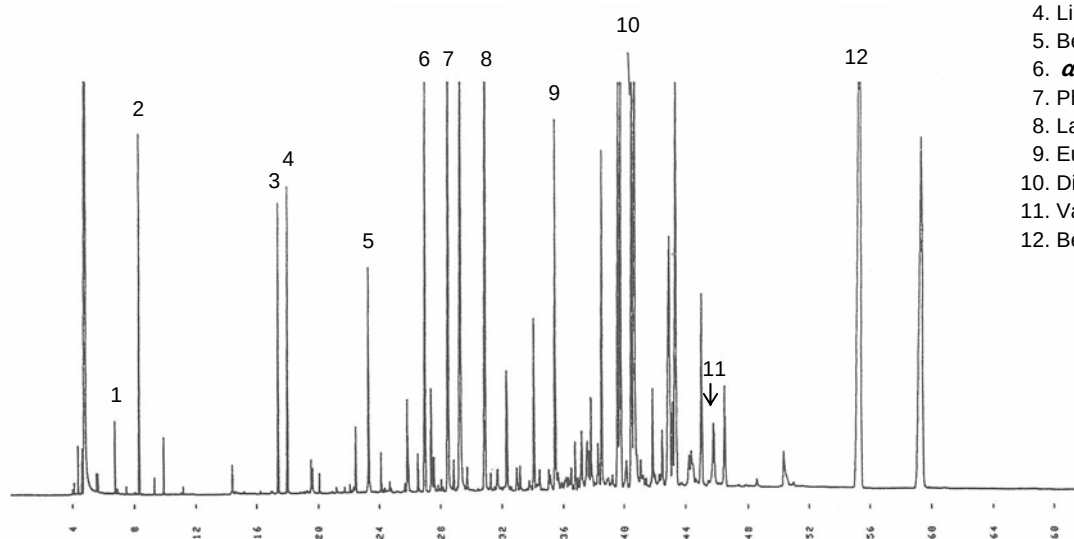
Perfume (1)



1. α -Pinene
2. β -Pinene
3. Limonene
4. Linalool
5. Linalyl Acetate
6. Benzyl Acetate
7. Phenethyl Alcohol

Column : ULBON HR-Thermon-600T 50 m x 0.25 mm I.D.
 Column temp : 70 °C ~ 230 °C Program rate 4 °C/min
 Injection : 250 °C (Split ratio: 80 :1)
 Detector : FID (250 °C)
 Carrier gas : He, 1.1 mL/min
 Sample Volume: 1.0 μ L

Perfume (2)

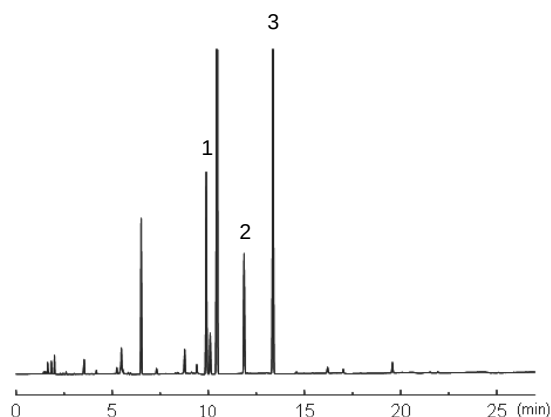


1. β -Pinene
2. Limonene
3. Linalool
4. Linalyl Acetate
5. Benzyl Acetate
6. α -Ionene
7. Phenethyl Alcohol
8. Lauryl Alcohol
9. Eugenol
10. Diethyl Phthalate
11. Vanillin
12. Benzyl Salicylate

Column : ULBON HR-Thermon-600T 50 m x 0.25 mm I.D.
 Column temp : 70 °C ~ 230 °C Program rate 4 °C/min
 Injection : 250 °C (Split ratio: 80 :1)
 Detector : FID (250 °C)
 Carrier gas : He, 1.1 mL/min
 Sample Volume: 1.0 μ L

Narcissus

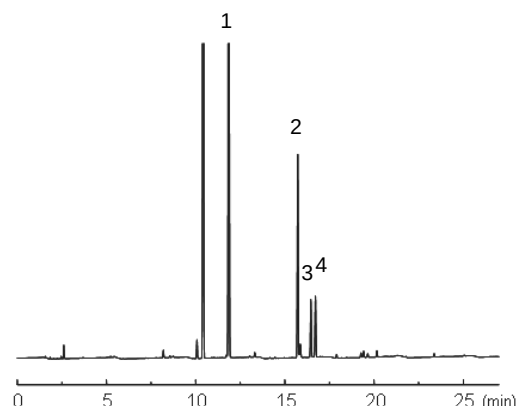
1. 1,8-Cineole
2. β -Phenethyl Alcohol
3. Benzyl Acetate



Column : ULBON HR-1 30 m x 0.32 mm I.D.df = 0.25 μ m
 Column temp : 50 $^{\circ}$ C ~ 200 $^{\circ}$ C Program rate 5 $^{\circ}$ C/min
 Injection : 250 $^{\circ}$ C (Split ratio: 10 :1)
 Detector : FID (250 $^{\circ}$ C)
 Carrier gas : He, 2.4 mL/min

Fragrant daphne

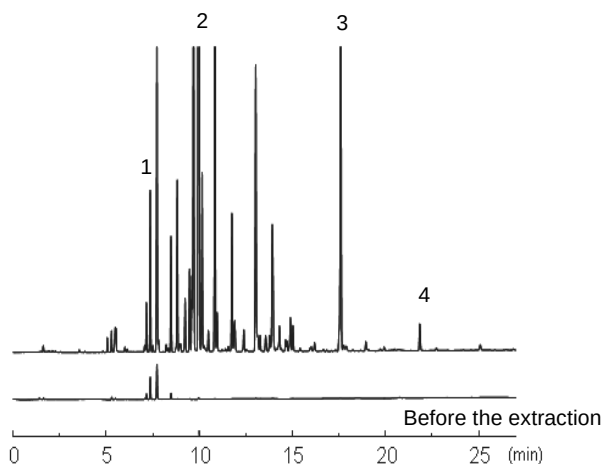
1. Linalool
2. Anisaldehyde
3. Geraniol
4. Perillaldehyde



Column : ULBON HR-1 30 m x 0.32 mm I.D.df = 0.25 μ m
 Column temp : 50 $^{\circ}$ C ~ 200 $^{\circ}$ C Program rate 5 $^{\circ}$ C/min
 Injection : 250 $^{\circ}$ C (Split ratio: 10 :1)
 Detector : FID (250 $^{\circ}$ C)
 Carrier gas : He, 2.4 mL/min

Rosemary

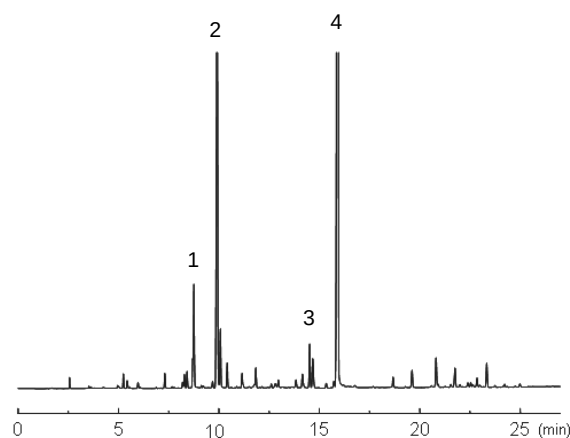
1. α -Pinene
2. Limonene
3. Isobornyl Acetate
4. α -Ionone



Column : ULBON HR-1 30 m x 0.32 mm I.D.df = 0.25 μ m
 Column temp : 50 $^{\circ}$ C ~ 200 $^{\circ}$ C Program rate 5 $^{\circ}$ C/min
 Injection : 250 $^{\circ}$ C (Split ratio: 10 :1)
 Detector : FID (250 $^{\circ}$ C)
 Carrier gas : He, 2.4 mL/min

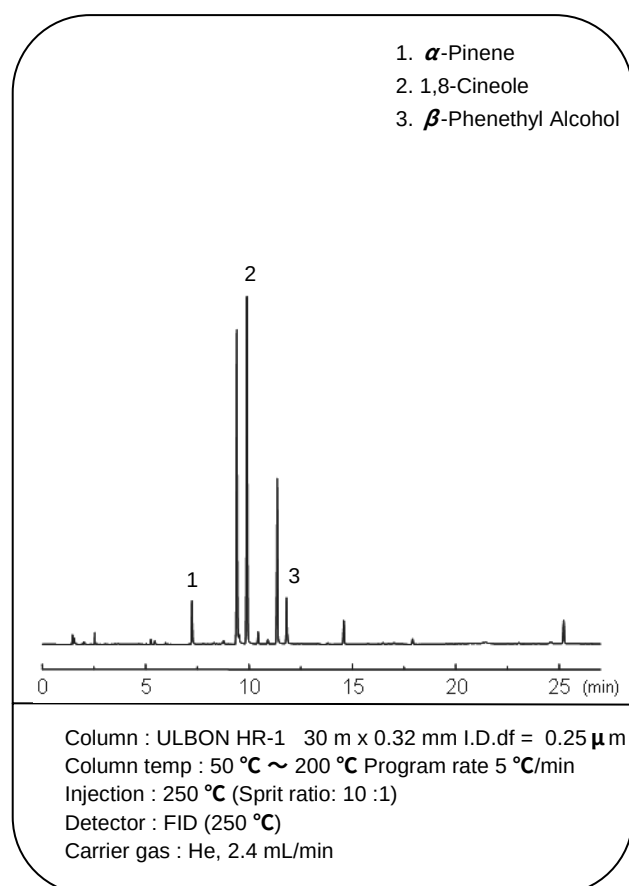
Peppermint

1. Myrcene
2. 1,8-Cineole
3. L-Menthol
4. Anisaldehyde

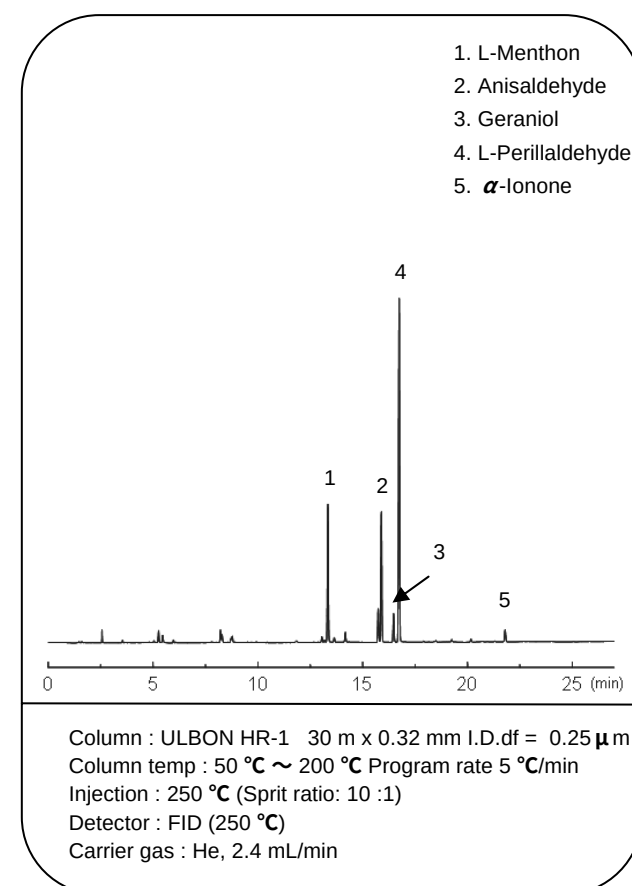


Column : ULBON HR-1 30 m x 0.32 mm I.D.df = 0.25 μ m
 Column temp : 50 $^{\circ}$ C ~ 200 $^{\circ}$ C Program rate 5 $^{\circ}$ C/min
 Injection : 250 $^{\circ}$ C (Split ratio: 10 :1)
 Detector : FID (250 $^{\circ}$ C)
 Carrier gas : He, 2.4 mL/min

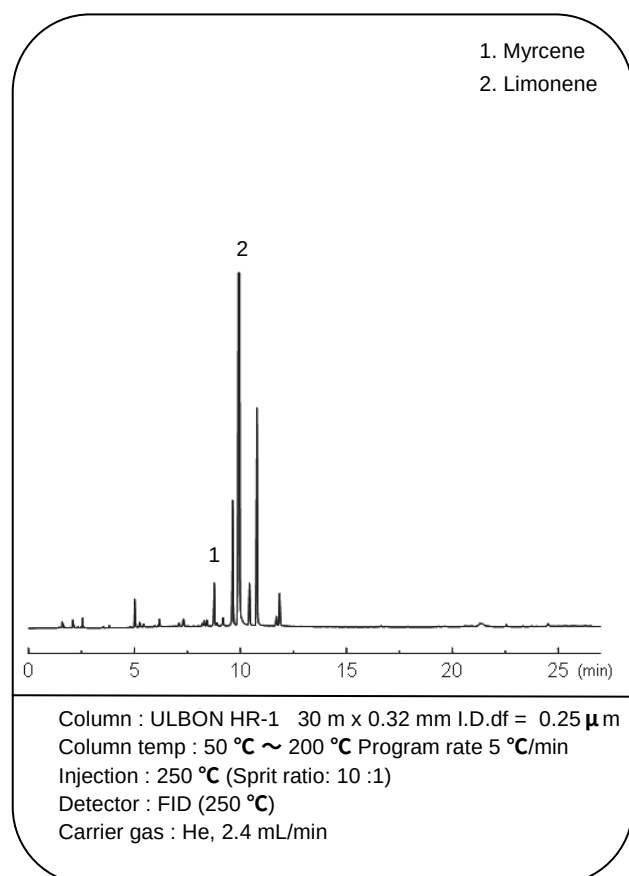
Angels trumpet



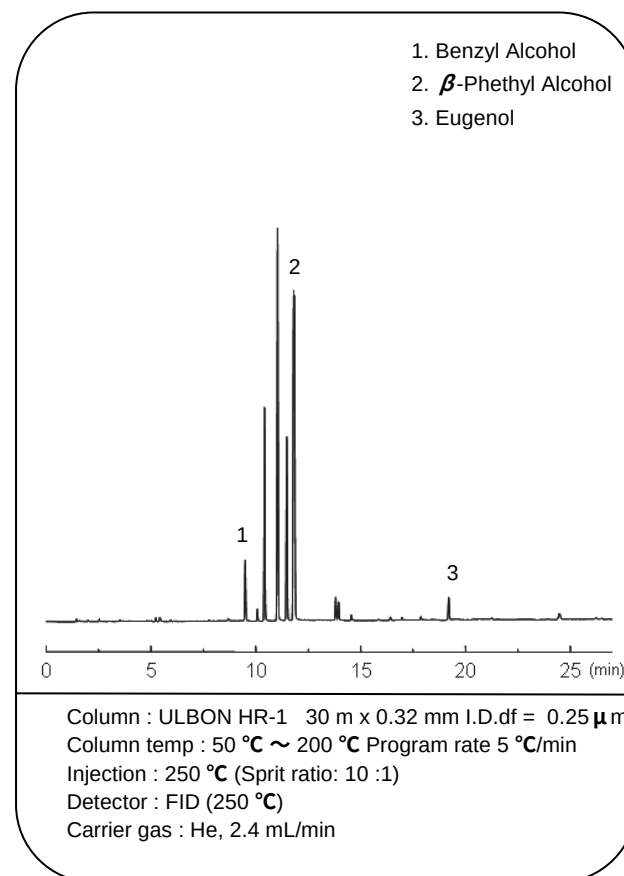
Lemon balm



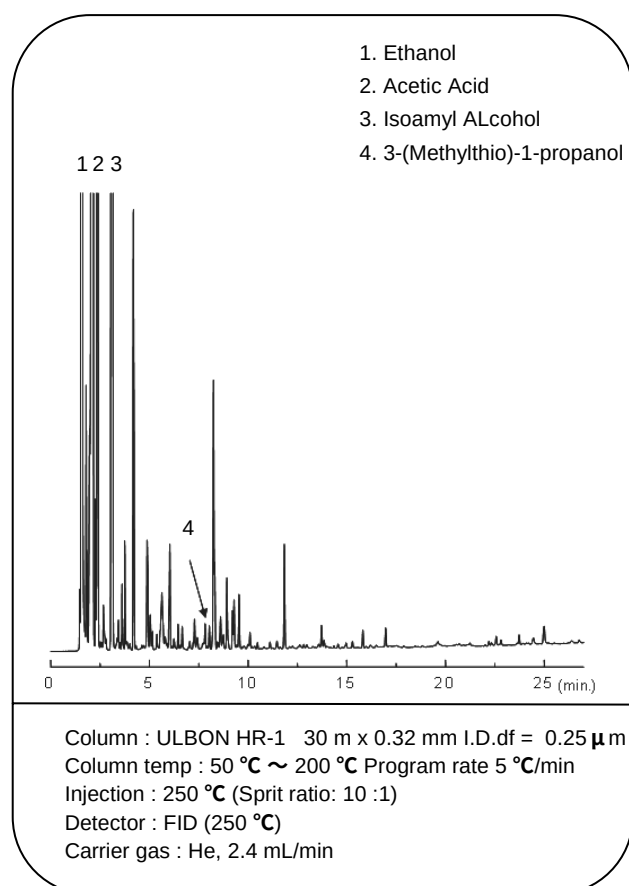
Yuzu citron



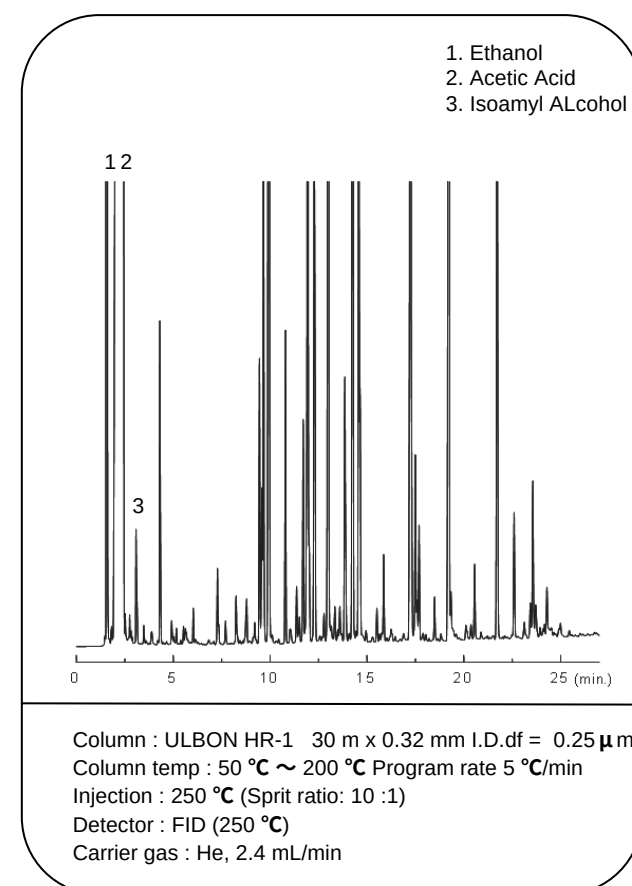
Holly tree



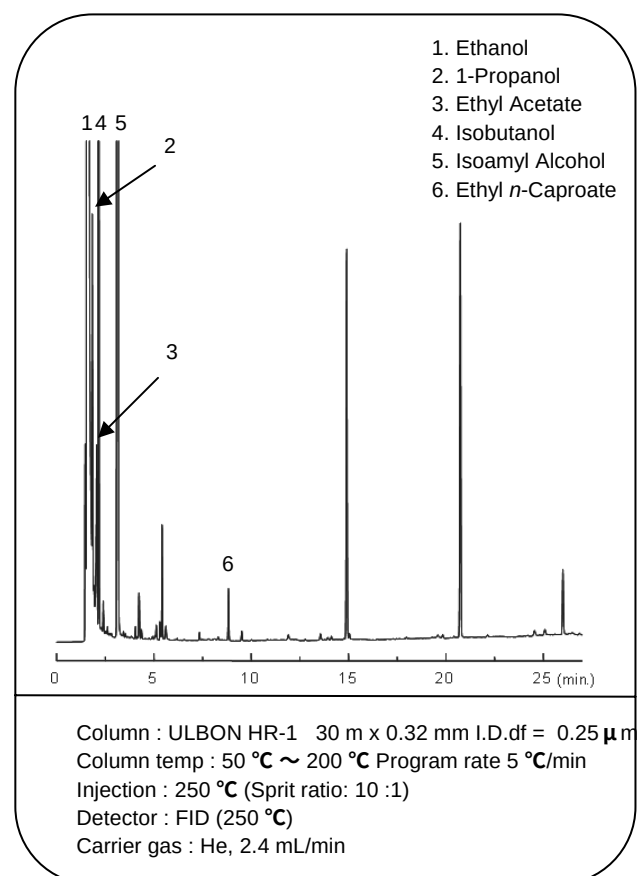
Soy sauce



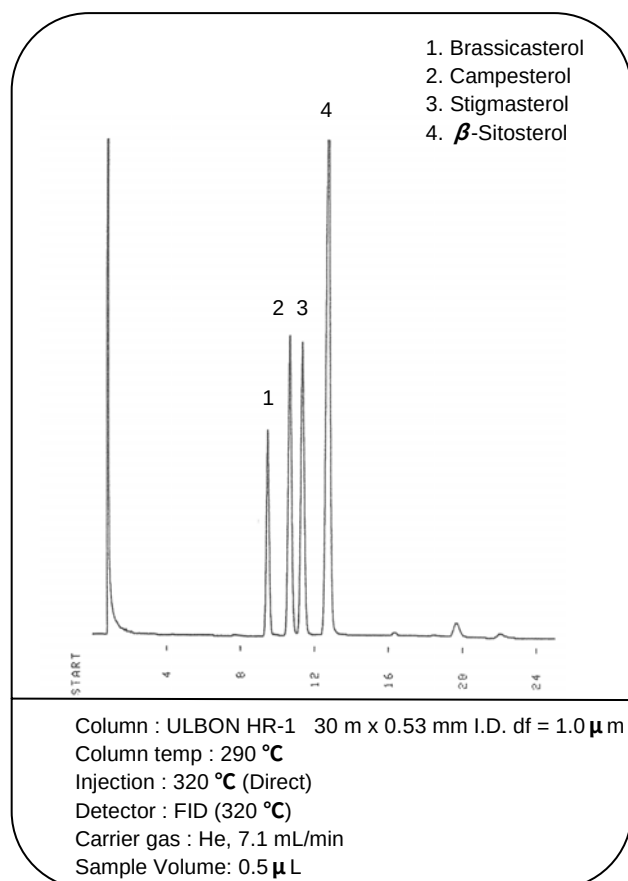
Worcestershire sauce



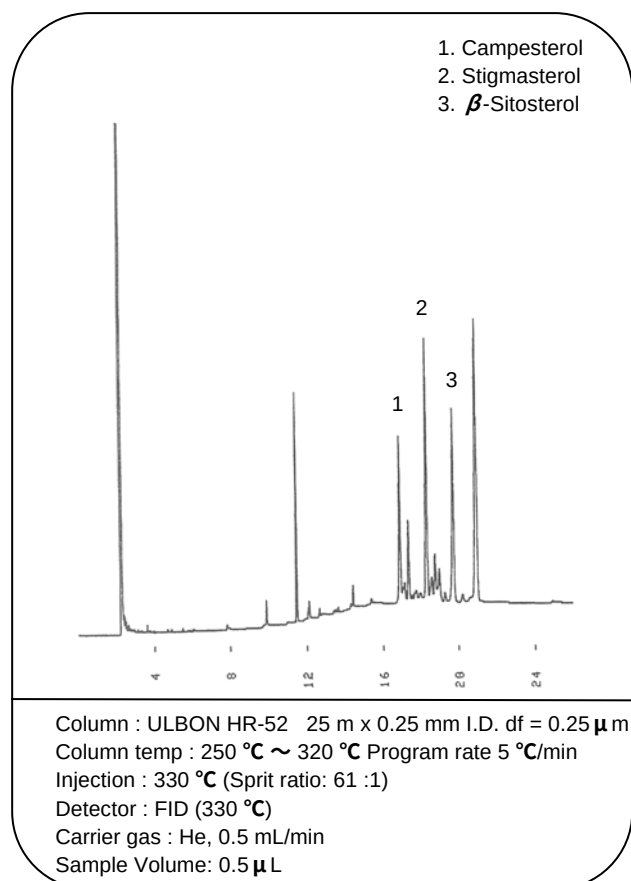
Brandy



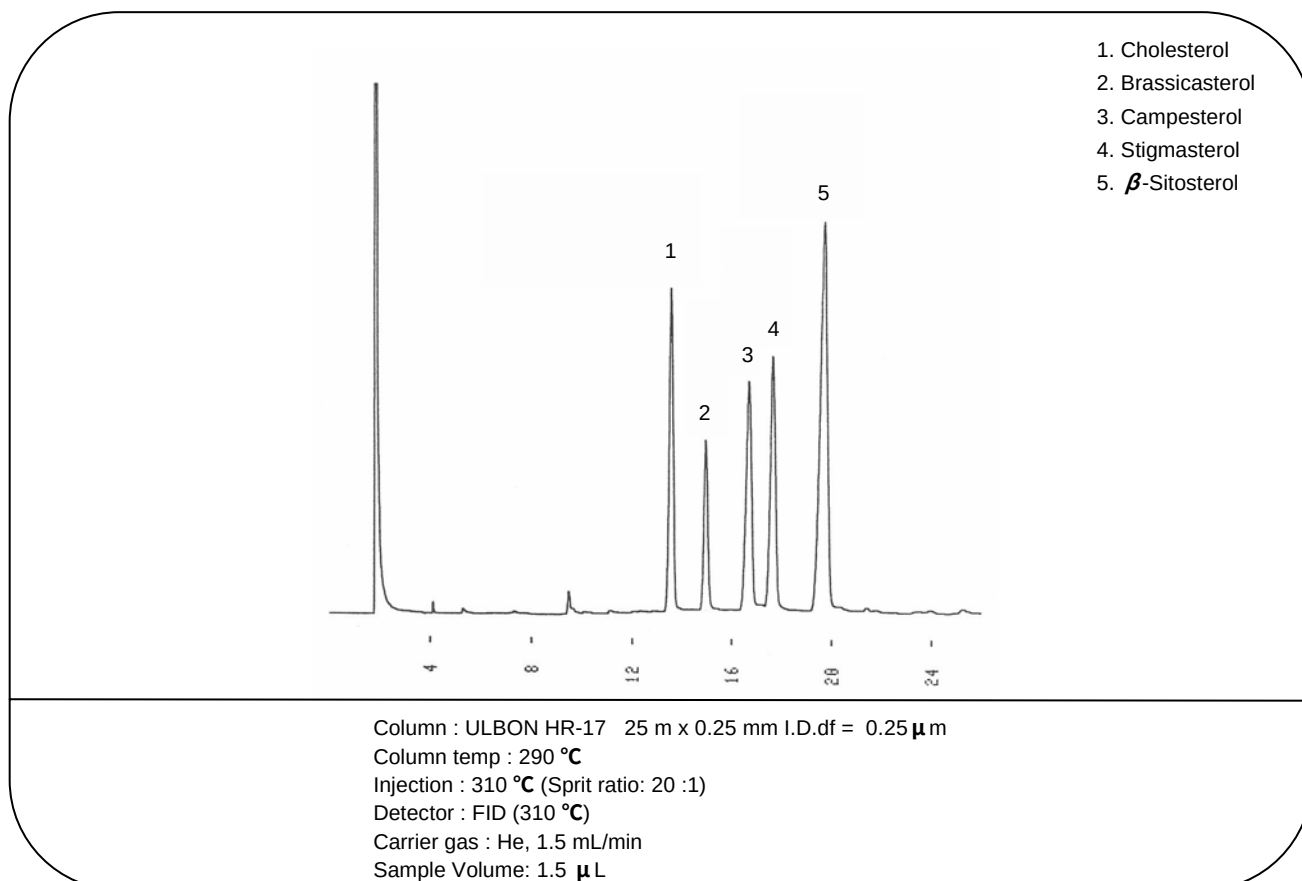
Plant sterols



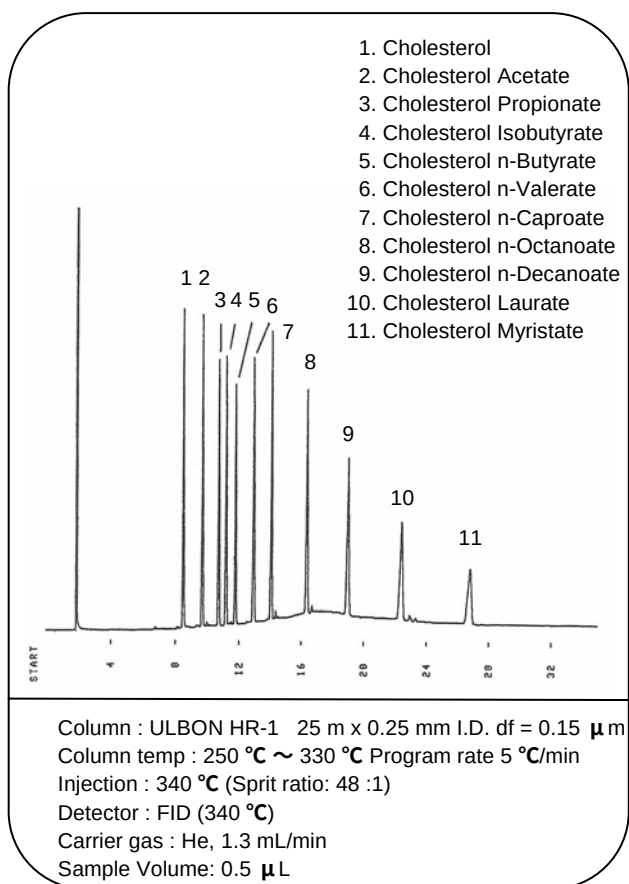
Plant sterols in rice bran oil



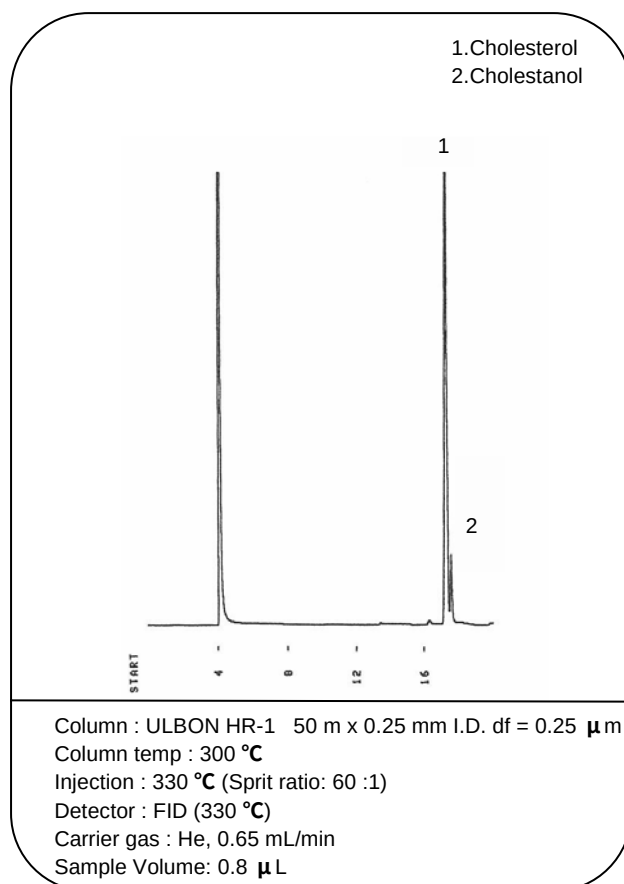
Cholesterol and Plant sterols



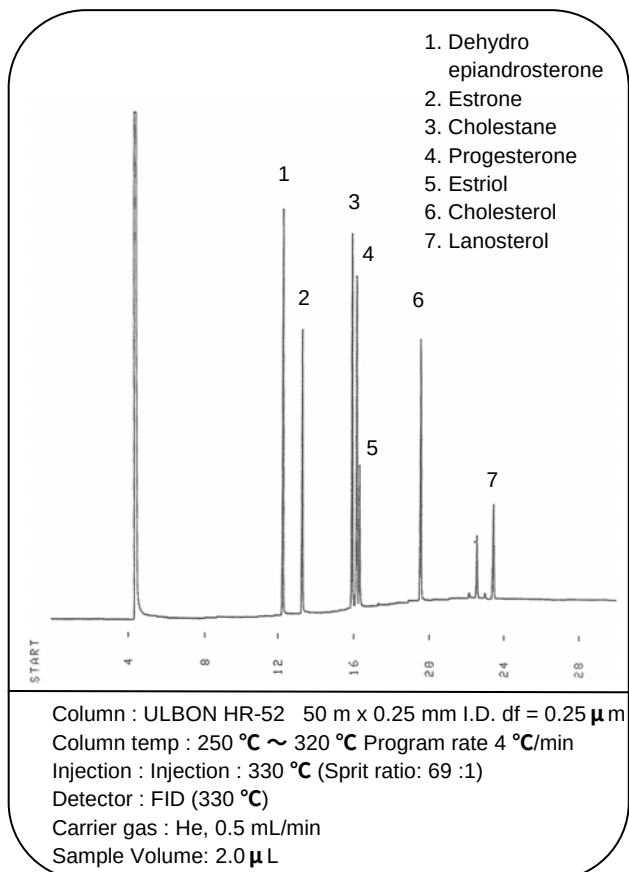
Cholesterol esters



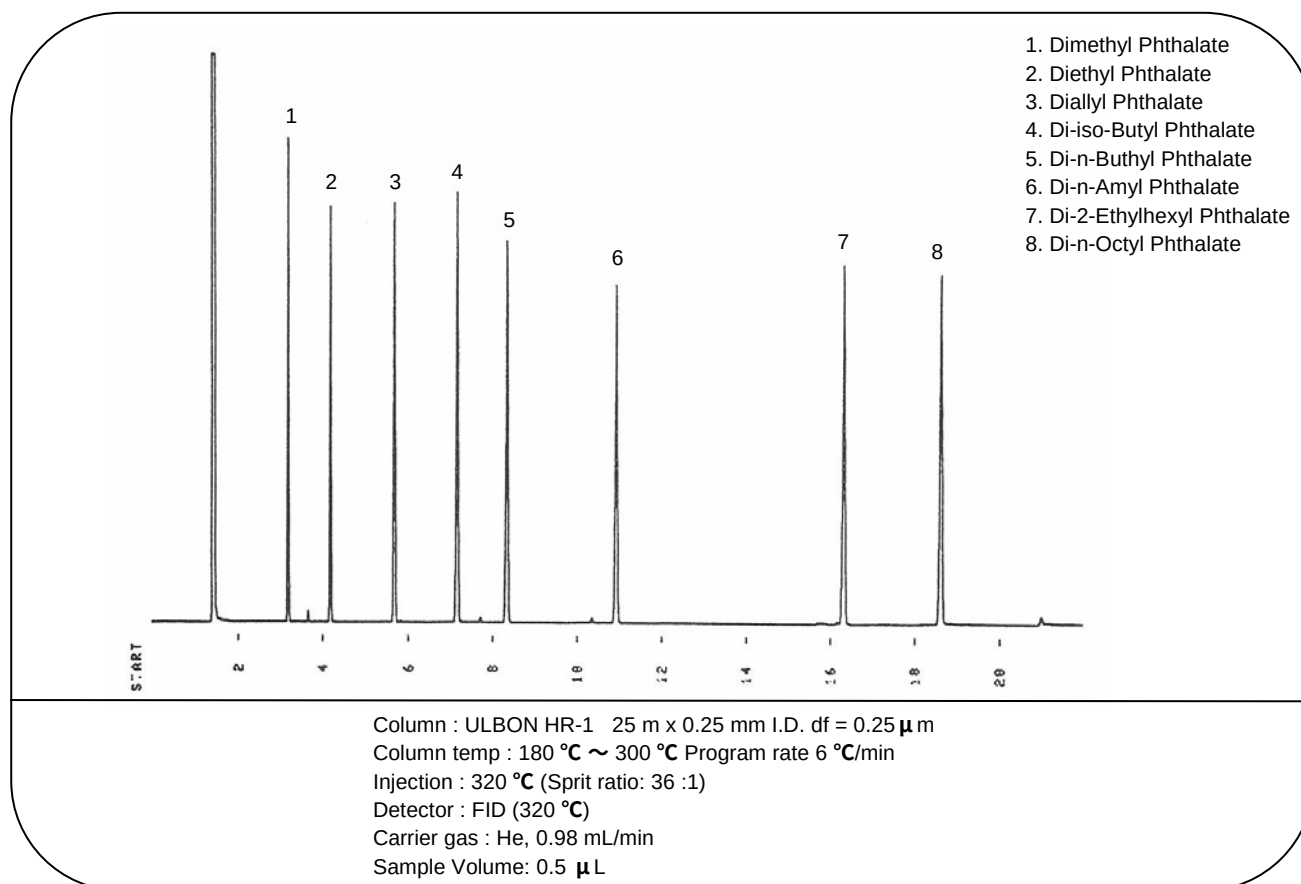
Cholesterol & Cholestanol



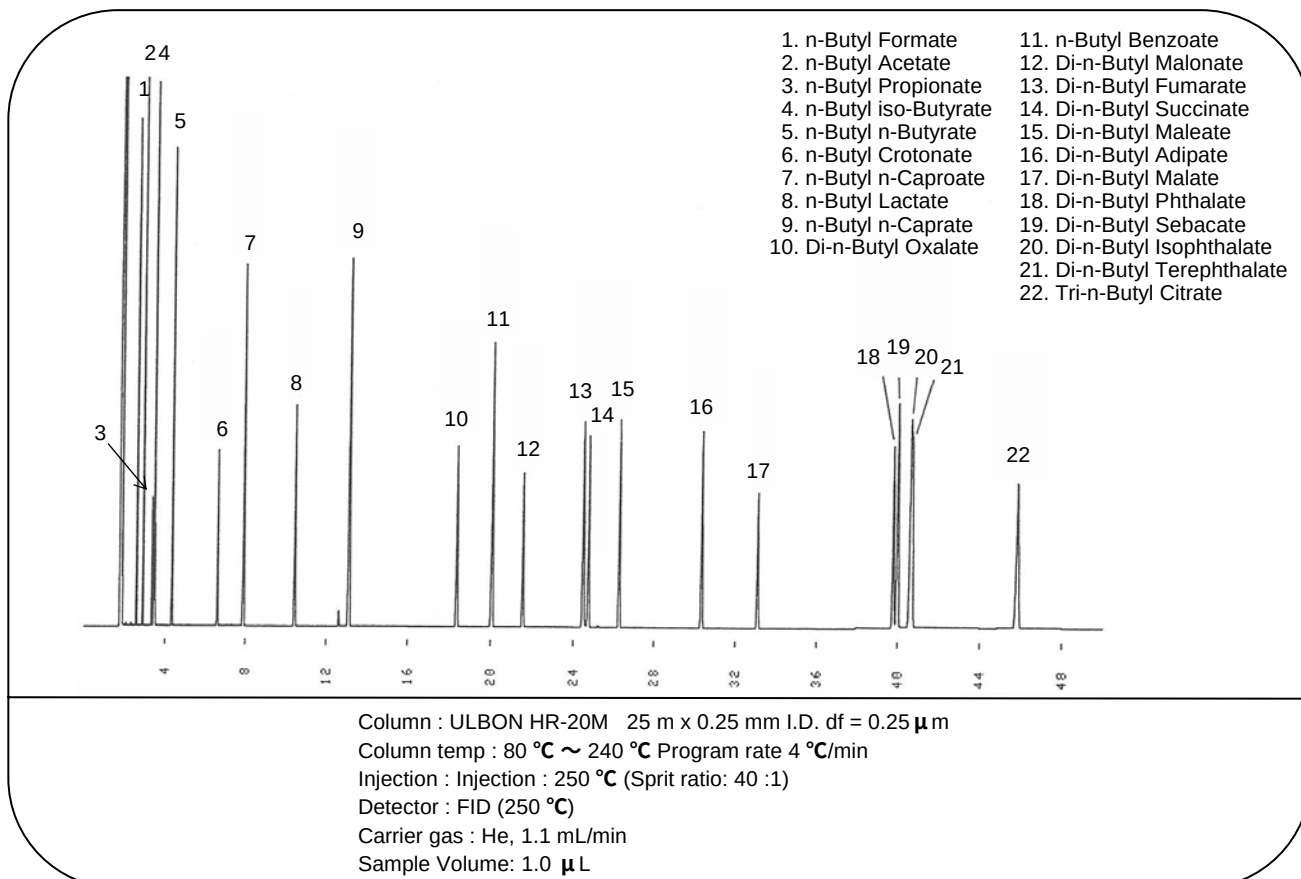
Sterols



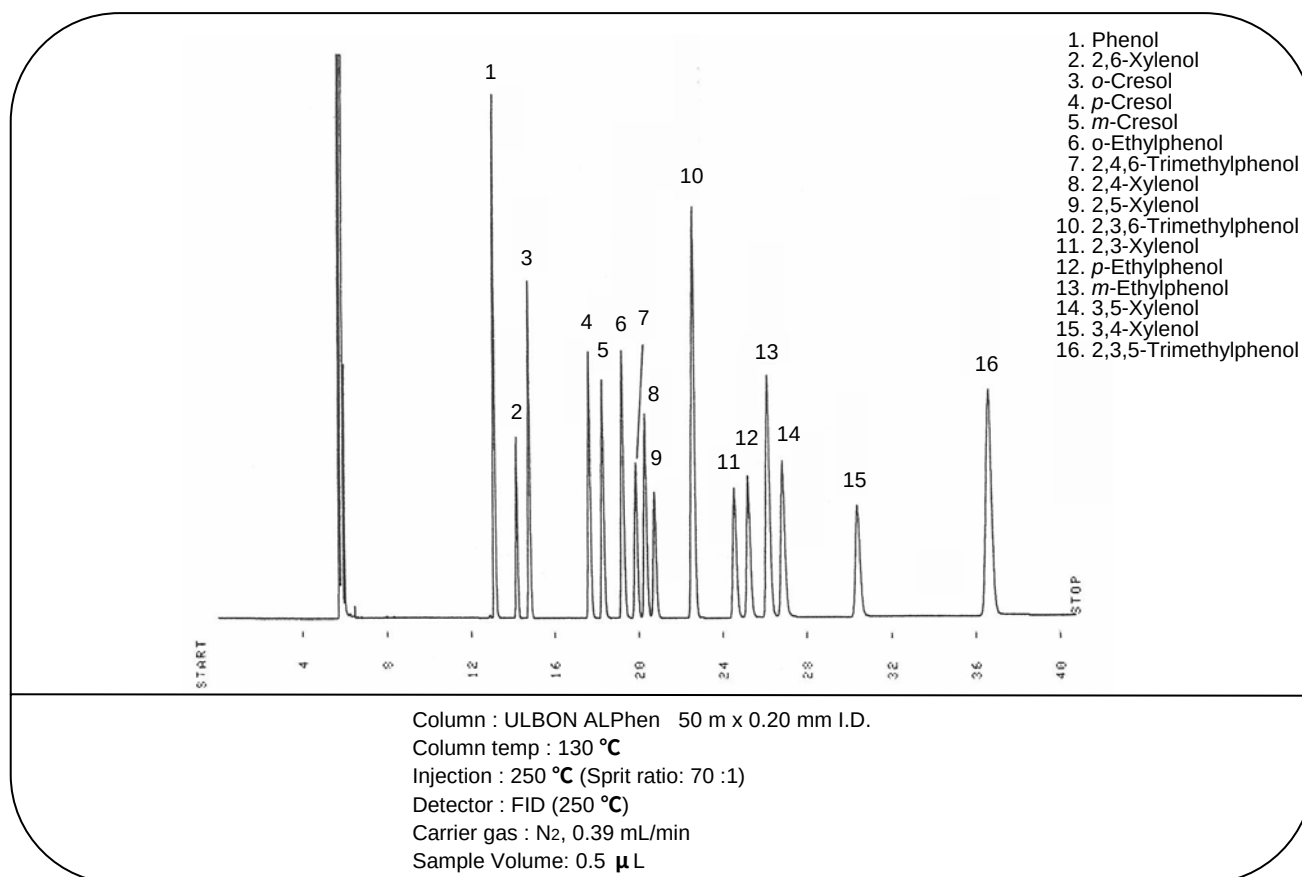
Phthalic acid esters



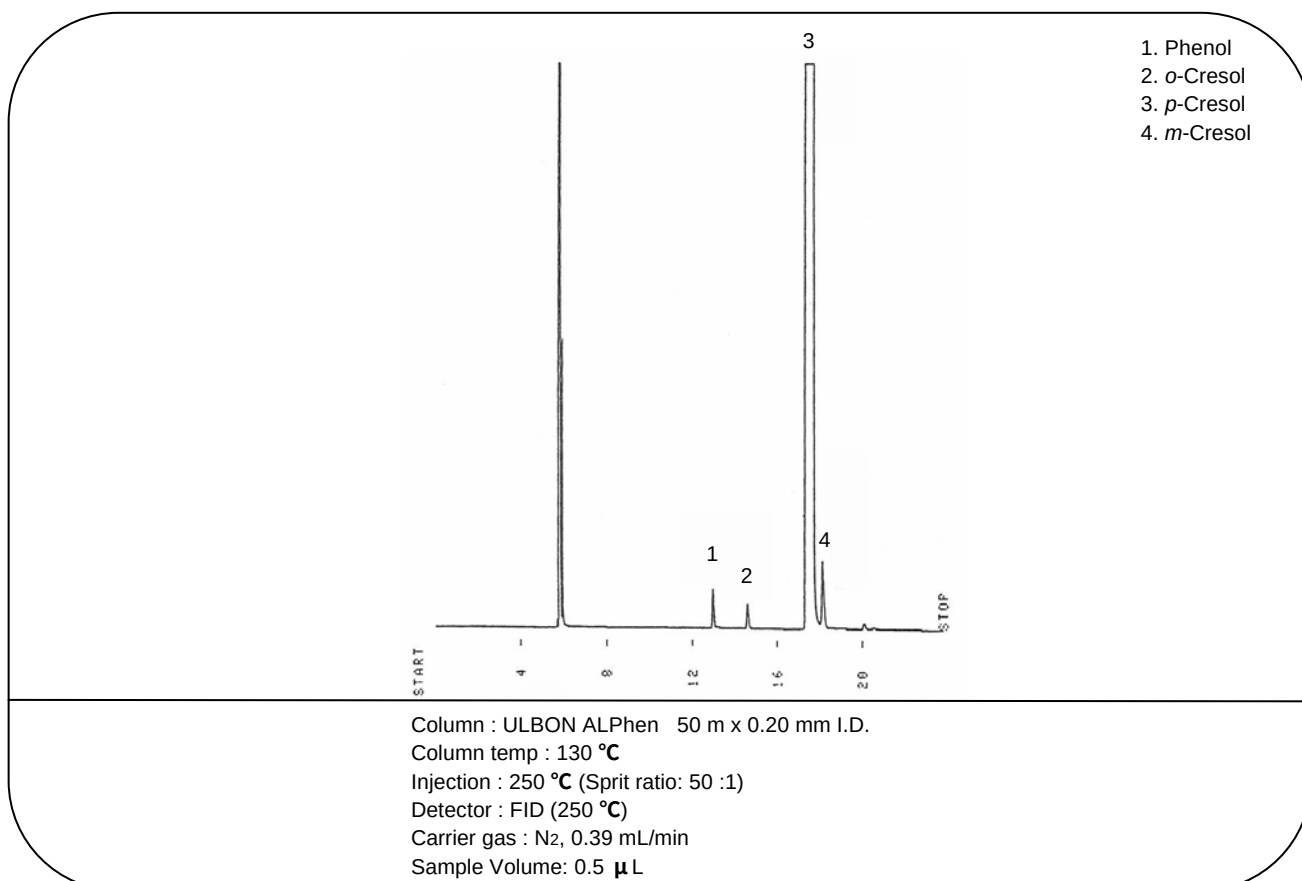
Organic acid butyl esters



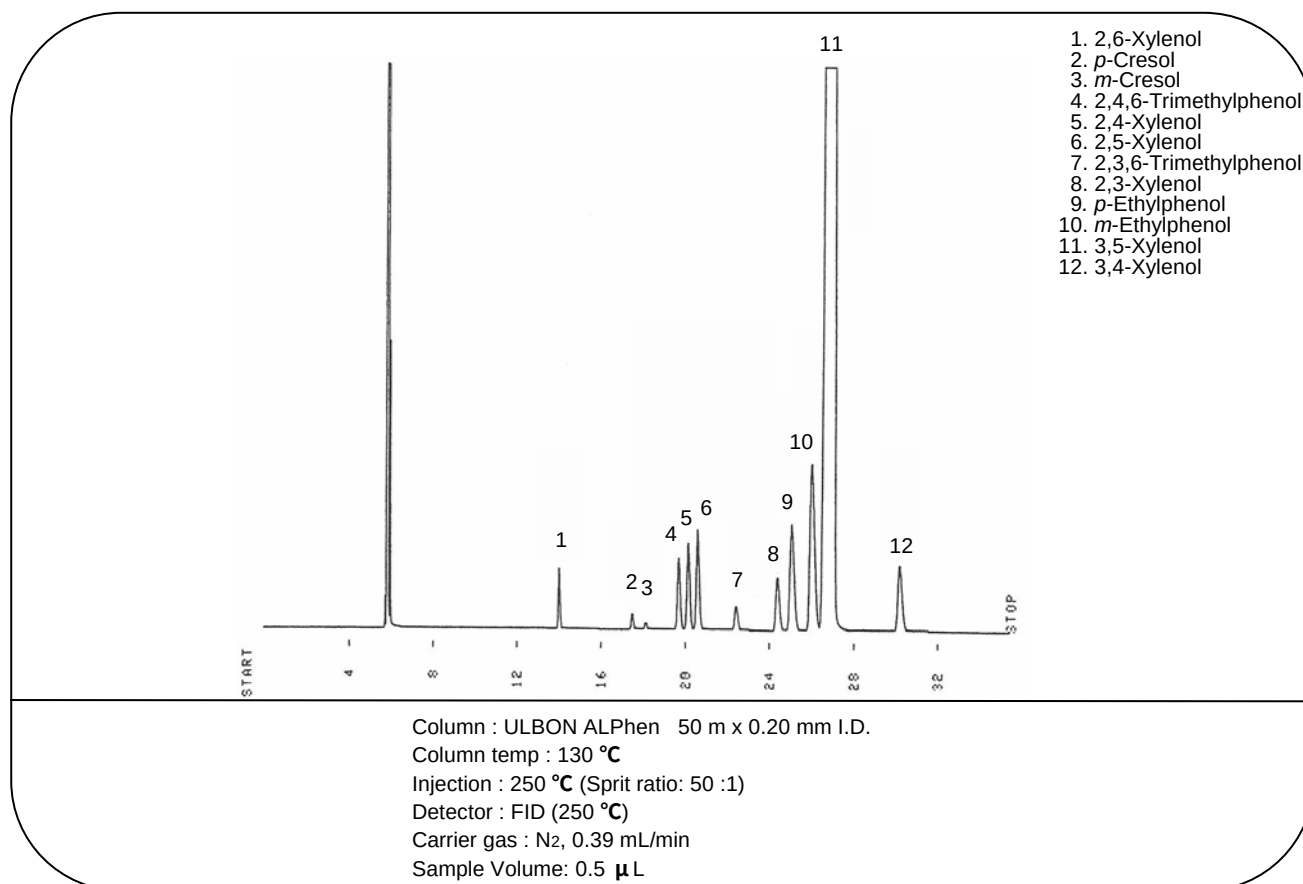
Alkylphenol isomers



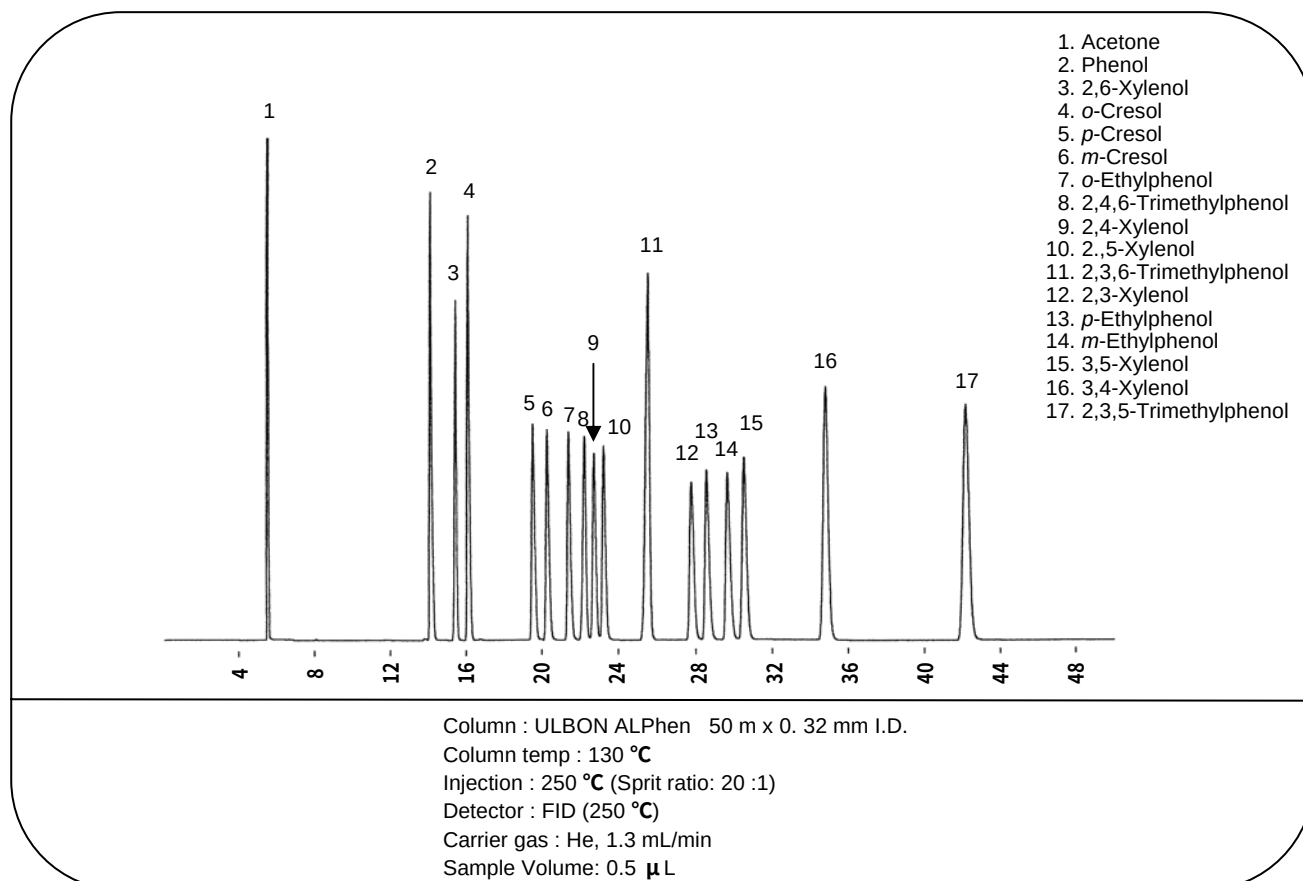
m-Cresol in *p*-Cresol (10% benzene solution)



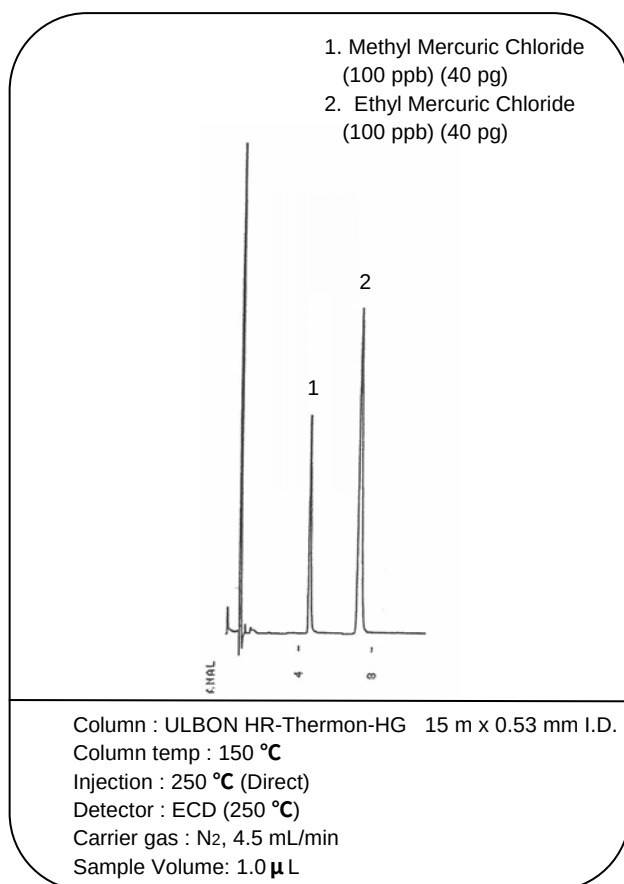
Impurities in 3,5-xyleneol (10% benzene solution)



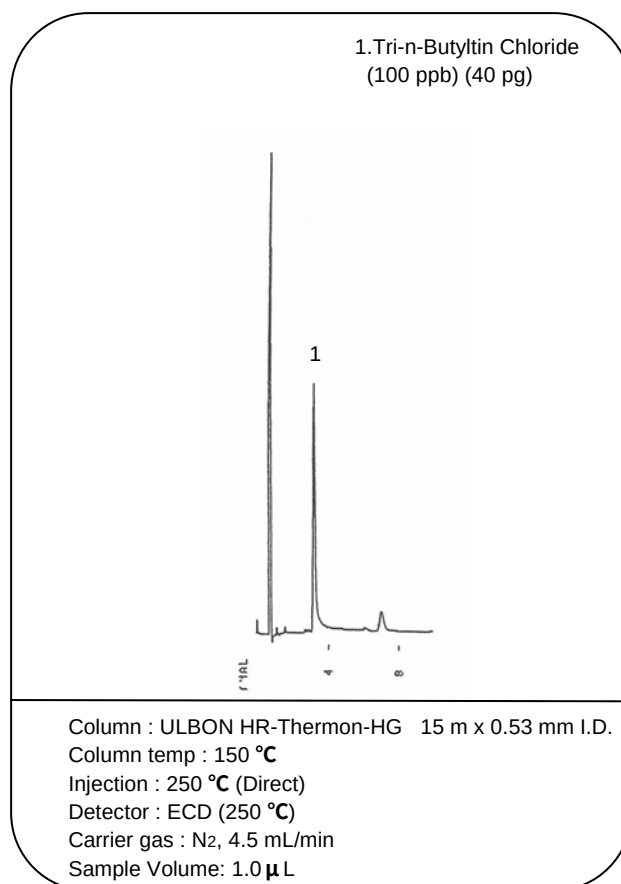
Alkylphenol mixture (0.1 ~ 0.3% Acetone solution)



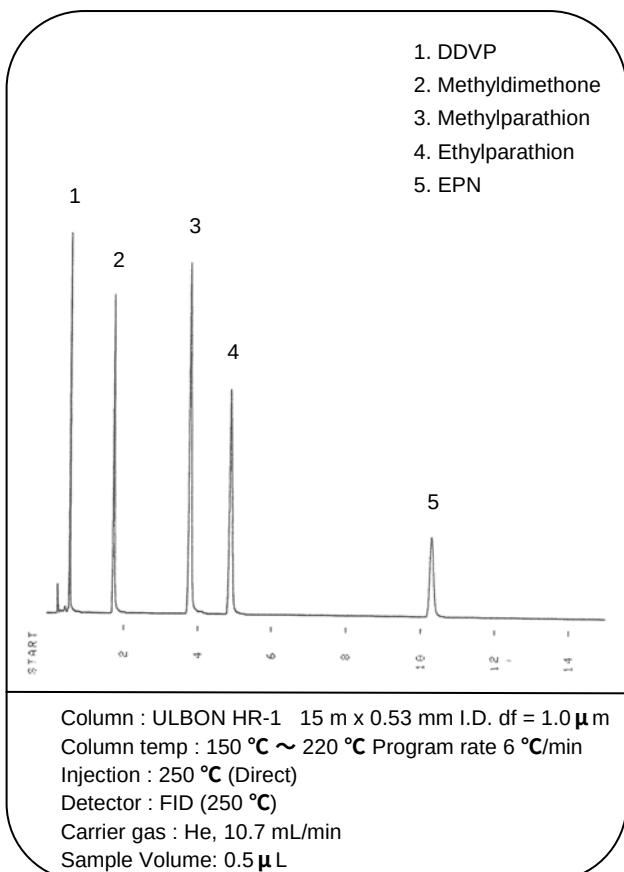
Alkyl Mercury



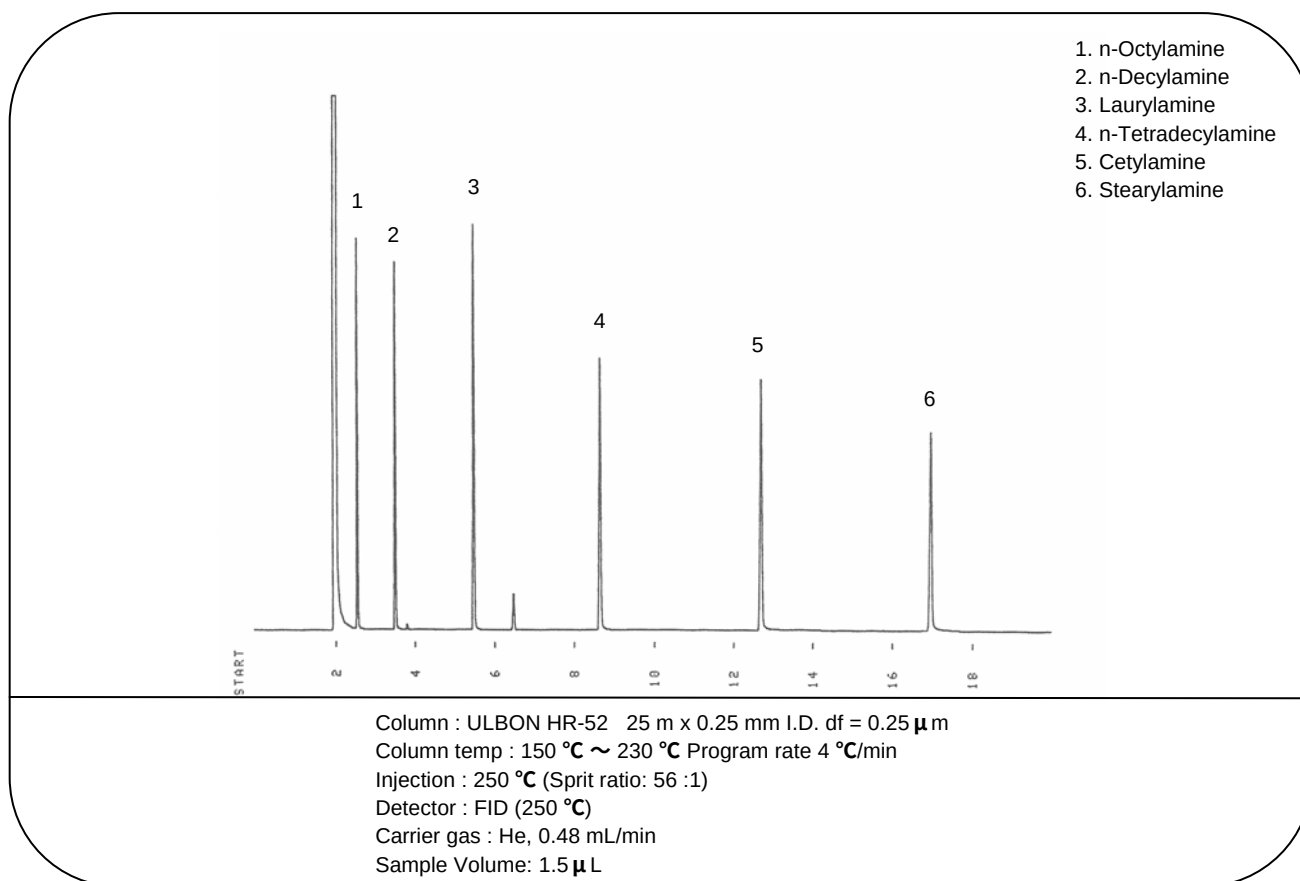
Tri-*n*-Butyltin Chloride



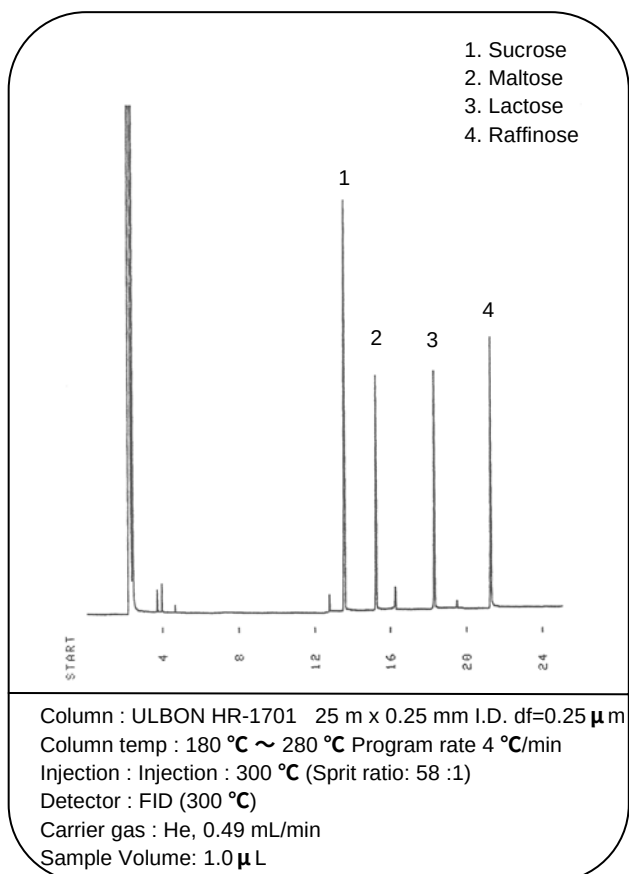
Organic phosphorus pesticides



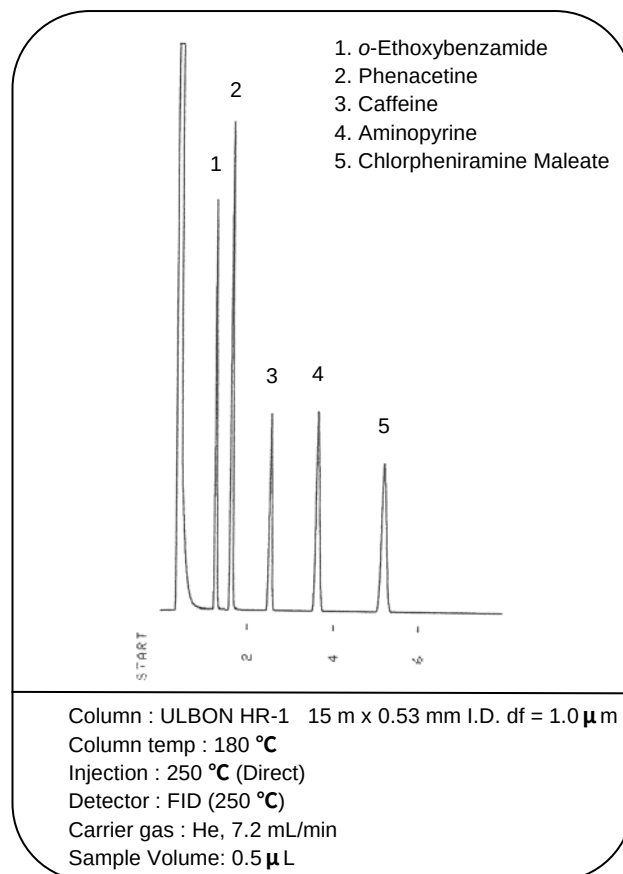
Aliphatic amines



Sugars (Acetate)



Medicines



Application Index

A	
Acetaldehyde	22
Acetic Acid	24, 34
Acetone	18, 19, 20, 21, 39
Acrylonitrile	14
Active Amyl Alcohol	18, 22
Aminopyrine	41
n-Amyl Acetate	18, 20, 21
Anisaldehyde	32, 33
Anthracene	14
B	
Benzene	12, 13, 14, 16, 18, 19
1,2-Benzpyrene	14
4,5-Benzpyrene	14
Benzyl Acetate	31, 32
Benzyl Alcohol	33
Benzyl Salicylate	31
Biphenyl	14
Brassicasterol	35
n-Butanol	18, 19, 20, 21
2-Butanol	18
n-Butyl Acetate	18, 19, 20, 21, 37
n-Butyl Benzoate	37
n-Butyl n-Butyrate	37
n-Butyl iso-Butyrate	37
n-Butyl n-Caprate	37
n-Butyl n-Caproate	37
Butyl Cellosolve	19, 20
n-Butyl Crotonate	37
n-Butyl Formate	37
n-Butyl Lactate	37
n-Butyl Propionate	37
n-Butyric Acid	24
iso-Butyric Acid	24
C	
Caffeine	41
Campesterol	35

Application Index

C	
iso-Caproic Acid	24
n-Caproic Acid	24
Carbon Tetrachloride	18, 19, 21
Cellosolve Acetate	18, 19, 20
Cetylamine	41
Chlorobenzene	18, 19, 21
Chloroform	18, 19, 20, 21
Chlorpheniramine Maleate	41
Cholestane	36
Cholesterol	36
Cholesterol Acetate	35, 36
Cholesterol n-Butyrate	36
Cholesterol n-Caproate	36
Cholesterol n-Decanoate	36
Cholesterol Isobutyrate	36
Cholesterol Laurate	36
Cholesterol Myristate	36
Cholesterol n-Octanoate	36
Cholesterol Propionate	36
Cholesterol n-Valerate	36
Chrysene	14
1,8-Cineole	32, 33
<i>m</i> -Cresol	20, 21, 38, 39
<i>o</i> -Cresol	18, 19, 20, 21, 38, 39
<i>p</i> -Cresol	18, 19, 20, 21, 38, 39
Cyclohexanol	20, 21
Cyclohexanone	18, 20, 21
D	
DDVP	40
n-Decylamine	41
Dehydroepiandrosterone	36
Diallyl Phthalate	37
Di-n-Amyl Phthalate	37
Di-n-Buthyl Phthalate	37
Di-n-Butyl Adipate	37

Application Index

D	
Di-n-Butyl Fumarate	37
Di-n-Butyl Isophthalate	37
Di-n-Butyl Malate	37
Di-n-Butyl Maleate	37
Di-n-Butyl Malonate	37
Di-n-Butyl Oxalate	37
Di-n-Butyl Phthalate	37
Di-iso-Butyl Phthalate	37
Di-n-Butyl Sebacate	37
Di-n-Butyl Succinate	37
Di-n-Butyl Terephthalate	37
<i>m</i> -Dichlorobenzene	18, 19, 20, 21
<i>o</i> -Dichlorobenzene	18, 19, 20, 21
<i>p</i> -Dichlorobenzene	18, 19, 20, 21
1,2-Dichloroethane	18, 20
<i>trans</i> -1,2-Dichloroethylene	21
<i>cis</i> -1,2-Dichloroethylene	20
<i>trans</i> -1,2-Dichloroethylene	18, 19, 20
Dichloromethane	18, 19, 20, 21
Diethyl Phthalate	31, 37
Di-2-Ethylhexyl Phthalate	37
Dimethyl Phthalate	37
N,N-Dimethylformamide	14, 20
1,2-DMN	15
1,3-DMN	15
1,4-DMN	15
1,5-DMN	15
1,6-DMN	15
1,7-DMN	15
1,8-DMN	15
2,3-DMN	15
2,6-DMN	15
2,7-DMN	15
Di-n-Octyl Phthalate	37
1,4-Dioxane	18, 19, 20, 21
Diphenyl	15

Application Index

D	
n-Docosanol	22
E	
n-Eicosane (C20)	10, 11
EPN	40
Estriol	36
Estrone	36
Ethanol	18, 19, 22, 34
<i>o</i> -Ethoxybenzamide	41
Ethyl Acetate	18, 19, 20, 21, 22, 34
Ethyl <i>n</i> -Caproate	34
Ethyl Cellosolve	20
Ethyl Ether	18, 20, 21
Ethyl Mercuric Chloride	40
Ethylbenzene	12, 13, 14, 16, 17, 18, 19, 20, 21
1-Ethyl ⁿ aphthalene	15
2-Ethyl ⁿ aphthalene	15
Ethylparathion	40
<i>m</i> -Ethylphenol	38, 39
<i>o</i> -Ethylphenol	38, 39
<i>p</i> -Ethylphenol	38, 39
<i>m</i> -Ethyltoluene	12, 13, 16, 17
<i>p</i> -Ethyltoluene	12, 13, 16, 17
<i>o</i> -Ethyltoluene	12, 13, 16
Eugenol	31, 33
F	
Fluoranthene	14
Fluorene	14
G	
Geraniol	32, 33
H	
n-Heptanoic Acid	24
n-Hexacosane	10, 11
n-Hexane	12, 13, 16, 18, 19, 20, 21
n-Hexatriacontane	10, 11
I	
α -Ionene	31, 32, 33

Application Index

I	
Isoamyl Acetate	18, 20, 21
Isoamyl Alcohol	18, 20, 22, 34
Isobornyl Acetate	32
Isobutanol	20, 21, 34
Isobutyl Acetate	18, 19
Isopropanol	20, 21
Isopropyl Acetate	20
Isopropylbenzene	16, 17
L	
Lactose	41
Lanosterol	36
Lauryl Alcohol	31
Laurylamine	41
Limonene	31, 32, 33
Linalool	31, 32
Linalyl Acetate	31
M	
Maltose	41
L-Menthon	32, 33
Methanol	18, 19, 20, 21
Methyl Acetate	20
Methyl Arachidate (C20:0)	24, 25, 26
Methyl Arachidonate (C20:4n6)	26
Methyl Behenate (C22:0)	24, 25, 26
2-Methyl-1-Butanol	22
3-Methyl-1-Butanol	22
Methyl n-Butyl Ketone	18, 19, 20, 21
Methyl Butyrate (C4:0)	26
Methyl Caprate (C10:0)	25, 26
Methyl Caproate (C6:0)	25, 26
Methyl Caprylate (C8:0)	26, 29, 30
Methyl Cellosolve	20
Methyl Cerotate (C26:0)	24
Methyl <i>cis</i> -13,16-Docosadienoate (C22:2)	26
Methyl <i>cis</i> -4,7,10,13,16,19-Docosahexaenoate (C22:6n3)	25, 26, 27, 28, 30
Methyl <i>cis</i> -7,10,13,16,19-Docosapentaenoate (C22:5n3)	27, 28, 30

Application Index

M	
Methyl <i>cis</i> -11,14-Eicosadienoate (C20:2)	26
Methyl <i>cis</i> -5,8,11,14,17-Eicosapentaenoate (C20:5n3)	26, 27, 28, 30
Methyl <i>cis</i> -,11,14,17-Eicosatrienoate (C20:3n3)	26
Methyl <i>cis</i> -8,11,14-Eicosatrienoate (C20:3n6)	26
Methyl <i>cis</i> -11-Eicosenoate (C20:1n9)	25, 26
Methyl Elaidate (C18:1n9t)	26, 29
Methyl Erucate (C22:1n9)	25, 26
Methyl Ethyl Ketone (MEK)	18, 19, 20
Methyl Henicosanoate (C21:0)	26
Methyl Heptadecanoate (C17:0)	26
Methyl <i>cis</i> -10-Heptadecenoate (C17:1)	26
Methyl Isobutyl Ketone (MIBK)	18, 19, 20, 21
Methyl Laurate (C12:0)	25, 26, 29, 30
Methyl Lignocerate (C24:0)	24, 25, 26
Methyl Linoleate (C18:2n6c)	25, 26, 27, 28, 29, 30
Methyl Linolelaidate (C18:2n6t)	26
Methyl Linolenate (C18:3n3)	25, 26, 27, 28, 29, 30
Methyl γ -Linolenate (C18:3n6)	26
Methyl Melissylate (C30:0)	24
Methyl Mercuric Chloride	40
Methyl Montanate (C28:0)	24
Methyl Myristate (C14:0)	25, 26, 27, 28, 29, 30
Methyl Myristoleate (C14:1)	26
Methyl Nervonate (C24:1n9)	25, 26
Methyl Oleate (C18:1n9c)	25, 26, 27, 28, 29, 30
Methyl Palmitate (C16:0)	25, 26, 27, 28, 29, 30
Methyl Palmitoleate (C16:1)	25, 26, 27, 28, 29, 30
Methyl Pentadecanoate (C15:0)	26
Methyl <i>cis</i> -10-Pentadecanoate (C15:1)	26
Methyl Stearate (C18:0)	25, 26, 27, 28, 29, 30
Methyl Tricosanoate (C23:0)	26
Methyl Tridecanoate (C13:0)	26
Methyl Undecanoate (C11:0)	26
2-Methylcyclohexanol	18, 20, 21
3-Methylcyclohexanol(<i>cis</i> , <i>trans</i>)	19
<i>cis</i> -4-Methylcyclohexanol	20

Application Index

M	
<i>trans</i> -4-Methylcyclohexanol	20
2-Methylcyclohexanone	19, 20, 21
3-Methylcyclohexanone	20
4-Methylcyclohexanone	18, 19, 20, 21
Methyl dimethone	40
1-Methylnaphthalene	15
2-Methylnaphthalene	15
Methylparathion	40
3-(Methylthio)-1-propanol	34
Myrcene	32, 33
N	
Naphthalene	12, 13, 14
n-Nonane	16
O	
n-Octadecanol	22
n-Octane	16
iso-Octane	12, 13
n-Octylamine	41
P	
n-Pentacosane	10, 11
n-Pentane	12, 13
3-Pentanol	22
L-Perillaldehyde	33
Perillaldehyde	32
Perylene	14
Phenacetine	41
Phenanthrene	14
Phenethyl Alcohol	31
β -Phenethyl Alcohol	32, 33
Phenol	38, 39
β -Phethyl Alcohol	33
α -Pinene	31, 32, 33
β -Pinene	31
Progesterone	36
1-Propanol	18, 19, 22, 34
2-Propanol	19, 20, 21

Application Index

P	
Propionic Acid	24
n-Propyl Acetate	18, 20
n-Propylbenzene	12, 13, 14, 16, 17
iso-Propylbenzene	12, 13, 14, 17
2-n-Propyltoluene	16
3-n-Propyltoluene	16
4-n-Propyltoluene	16
Pyrene	14
R	
Raffinose	41
S	
β -Sitosterol	35
Stearylamine	41
Stigmasterol	35
Styrene	14, 16, 18, 19, 20, 21
Sucrose	41
T	
<i>m</i> -Terphenyl	14
<i>o</i> -Terphenyl	14
<i>p</i> -Terphenyl	14
1,1,2,2-Tetrachloroethane	19, 20, 21
Tetrachloroethylene	18, 19, 20, 21
n-Tetradecylamine	41
Tetrahydrofuran	18, 19, 21
1,2,3,4-Tetramethylbenzene	16
1,2,3,5-Tetramethylbenzene	16
Toluene	12, 13, 14, 16, 17, 18, 19, 20, 21
Tri-n-Butyl Citrate	37
Tri-n-Butyltin Chloride	40
1,1,1-Trichloroethane	18, 19, 21
Trichloroethylene	19, 20, 21
Triglyceride	23
1,2,3-Trimethylbenzene	12, 13, 16
1,2,4-Trimethylbenzene	12, 13, 16
1,2,5-Trimethylbenzene	12, 13
1,3,5-Trimethylbenzene	16

Application Index

T	
2,3,5-Trimethylphenol	38, 39
2,3,6-Trimethylphenol	38, 39
2,4,6-Trimethylphenol	38, 39
V	
iso-Valeric Acid	24
Vanillin	31
X	
<i>m</i> -Xylene	12, 13, 16, 17, 18, 19, 20
<i>o</i> -Xylene	12, 13, 16, 17, 18, 19, 20, 21
<i>p</i> -Xylene	12, 13, 16, 17, 19, 20, 21
2,3-Xylenol	38, 39
2,4-Xylenol	38, 39
2,5-Xylenol	38, 39
2,6-Xylenol	38, 39
3,4-Xylenol	38, 39
3,5-Xylenol	38, 39

Product Index

ULBON HR-1	10, 12, 13, 14, 18, 32, 33, 34, 35, 36, 37, 40, 41
ULBON HR-52	11, 18, 19, 21, 22, 24, 35, 36, 41
ULBON HR-17	35
ULBON HR-1701	19, 20, 21, 41
ULBON HR-20M	12, 13, 14, 20, 22, 24, 25, 37
ULBON HR-SS-10	26, 27, 28, 29, 30
ULBON HR-Thermon-3000B	25
ULBON HR-Thermon-600T	31
ULBON HR-Thermon-HG	40
ULBON HR-TGC1	23
ULBON ALPhen	38, 39
ULBON DMN 267	15
ULBON PLC	15
ULBON Xylene Master	16, 17
ULBON SPX-1	17

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