New GC Column Technology for Old Problems in Fatty Acid Analysis

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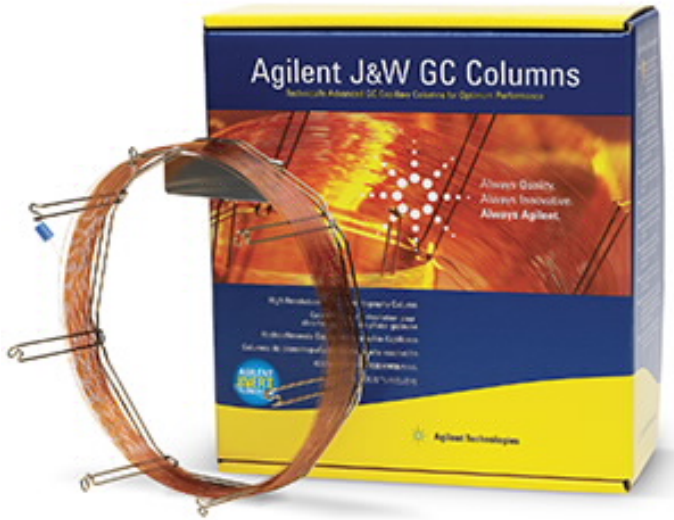


What Are We Testing?

Fat profiles:

- Total Fat
- Saturated Fat
- Monosaturated Fat
- Trans Fat

Free fatty acids

Triglycerides

Omega 3 and 6 fatty acids

Markets Where FAMEs in Food are Analyzed

Food/beverage testing labs

- Nutritional label testing/authenticity
- QA/QC analysis, Regulatory methods
  - AOCS
  - AOAC

Food processing/Mfg

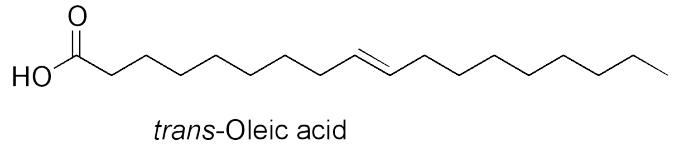
- Edible oils/dairy
- R&D, QA/QC, production

Fats and oil producers

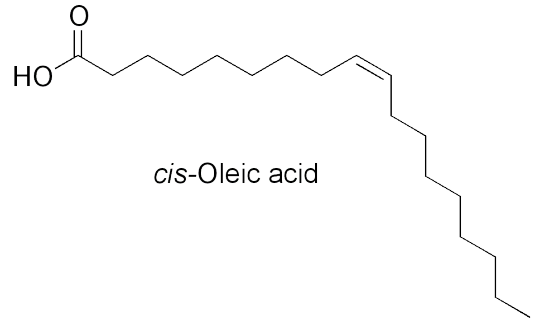
- Omega 3 and 6 supplements
- QA/QC, process control

Terminology

Fats, oils, FAMEs, triglycerides, fatty acids



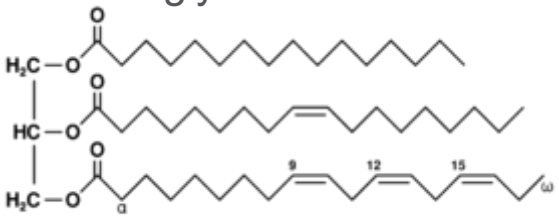
trans-Oleic acid



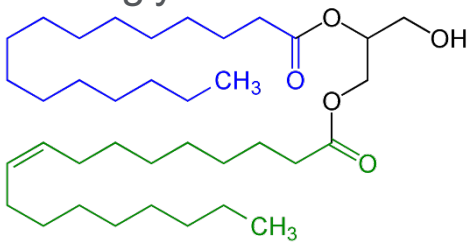
cis-Oleic acid

- Fatty acids: carboxylic acid with long aliphatic chain (C4 – C28)
- Vegetable oils: triglycerides from plants (seeds and nuts)
  mono and diglycerides in minor amounts

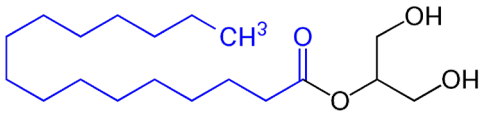
Triglycerides



Diglycerides



Monoglycerides



Fats = Triglycerides (animal or plant origin)

FAMEs: **fatty acid methyl esters** derived by transesterification of fats with methanol (in presence base)
FAEEs: fatty acid ethyl esters, naturally occurring in alcoholic beverages

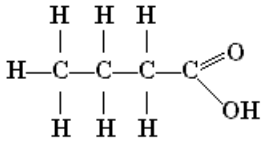
Structures of fats and oils
A triglyceride is called a fat if it is a solid at 25 °C; it is called an oil if it is a liquid at that temperature. These differences in melting points reflect differences in the degree of unsaturation and number of carbon atoms in the constituent fatty acids.

What Type of Fatty Acids are There?

Fatty acids are long-chain hydrocarbons that can be separated into three categories: saturated, monounsaturated (MUFA), and polyunsaturated (PUFAs).

Saturated fatty acids (SFAs):

Have all the hydrogen that the carbon atoms can hold and, therefore, have no double bonds between carbon atoms.



or CH3-CH2-CH2-COOH or CH3-(CH2)2-COOH

Butyric acid

Monounsaturated fatty acids (MUFAs): Have only one double bond

Polyunsaturated fatty acids (PUFAs): Have more than one double bond

CH3CH2CH2CH2CH2CH=CHCH2CH=CHCH2CH2CH2CH2CH2CH2CH2COOH

9,12-octadecadienoic acid (Linoleic acid) (C18:2)

Which would be abbreviated as:

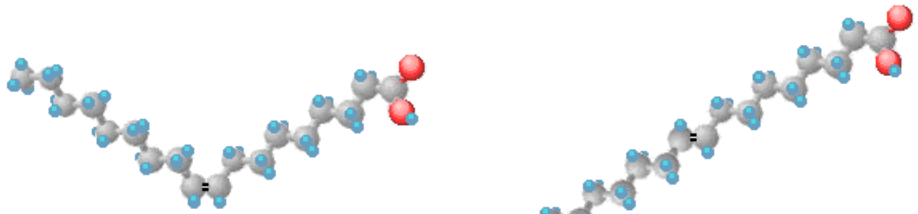
CH3(CH2)4CH=CHCH2CH=CH(CH2)7COOH

Fatty Acid Configurations

Fatty Acid Configurations

What are *Trans* Fats?

Double bonds bind carbon atoms tightly and prevent rotation of the carbon atoms along the bond axis. This gives rise to *configurational isomers* which are arrangements of atoms that can only be changed by breaking the bonds.



Cis-9-octadecenoic acid
(Oleic acid)

Trans-9-octadecenoic acid
(Elaidic acid)

These three-dimensional molecular projections show the *Cis* and *Trans* configurational isomers of 9-octadecenoic acid with the hydrogen atoms shown in blue. The Latin prefixes *Cis* and *Trans* describe the orientation of the hydrogen atoms with respect to the double bond. *Cis* means "on the same side" and *Trans* means "across" or "on the other side". Naturally occurring fatty acids generally have the *Cis* configuration. The natural form of 9-octadecenoic acid (oleic acid) found in olive oil has a "V" shape due to the *Cis* configuration at position 9. The *Trans* configuration (elaidic acid) looks more like a straight line.

Cis Configuration *Trans* Configuration

Fatty acids: Positional isomers – which position in the chain are the double bonds in
Geometrical isomers – what is the configuration of the bond (cis or trans)

Trans fats

Most trans fats are manufactured through a process called hydrogenation, which is the artificial addition of hydrogen atoms to unsaturated oils. Hydrogenation converts liquid vegetable oils to solid or semisolid fats that remain stable at room temperature. These fats can then be incorporated into certain food products (for example, cookies, chips) to increase shelf life.

Fatty Acid Composition of Palm Oil

The major fatty acids in palm oil are oleic acid, palmitic acid, and linoleic acid.

Composition	Content (mg/g)[a]	Composition	Content (mg/g)	Composition	Content (mg/g)
C12:0	2.06 ± 0.03	**cis C18:1**	336.98 ± 9.34	**11c C20:1**	0.33 ± 0.01
C14:0	9.97 ± 0.24	**9c 12t C18:2**	0.92 ± 0.07	**9c12c15cC18:3**	1.63 ± 0.05
C15:0	0.43 ± 0.02	**9t 12c C18:2**	0.79 ± 0.07	**trans C18:1[d]**	ND[b]
C16:0	465.49 ±11.08	**9c12c C18:2**	68.85 ± 2.66	**trans C18:2[e]**	1.71± 0.02
9cC16:1	1.12 ± 0.01	**C20:0**	1.65 ± 0.04	**trans C18:3[f]**	ND
C17:0	0.80 ± 0.01	**ctt/cct C18:3[c]**	ND	**C18:2/C16:0**	0.1479
C18:0	37.86 ± 0.76	**9t 12c15c C18:3**	ND	**C18:3/C16:0**	0.0035

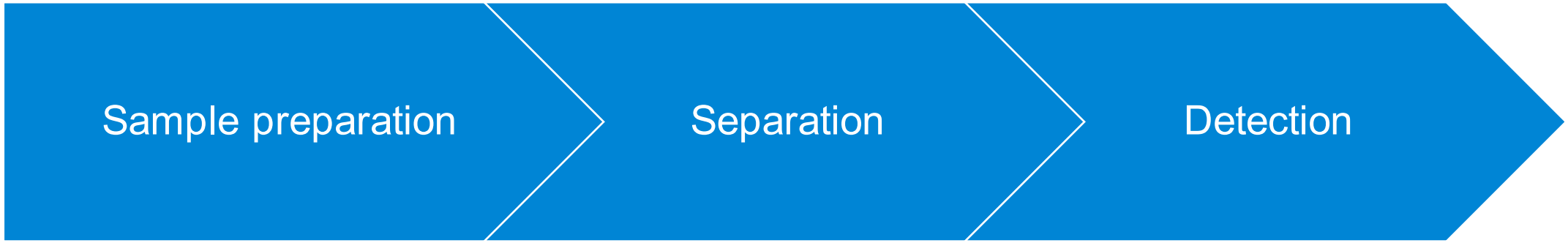
[a] Means of duplicate analyses ± standard deviation
[b] ND: not detected
[c] Total contents of *9c 12t 15t* C18:3 and *9c12c 15t* C18:3
[d] Total contents of *9t* C18:1 and *11t* C18:1
[e] Total contents of *9c 12t* C18:2 and *9t 12c* C18:2
[f] Total contents of *9c 12t 15t* C18:3, *9c12c 15t* C18:3 and *9t 12c15c* C18:3

Why Do We Analyze FAMEs?

Because of the highly polar and acidic end of free fatty acids, compounds often create tailing and the columns used have limited lifetime. A lengthy transesterification process taking 4 to 6 hours may be required.

Free fatty acids can be an analytical challenge

Basic Application Overview



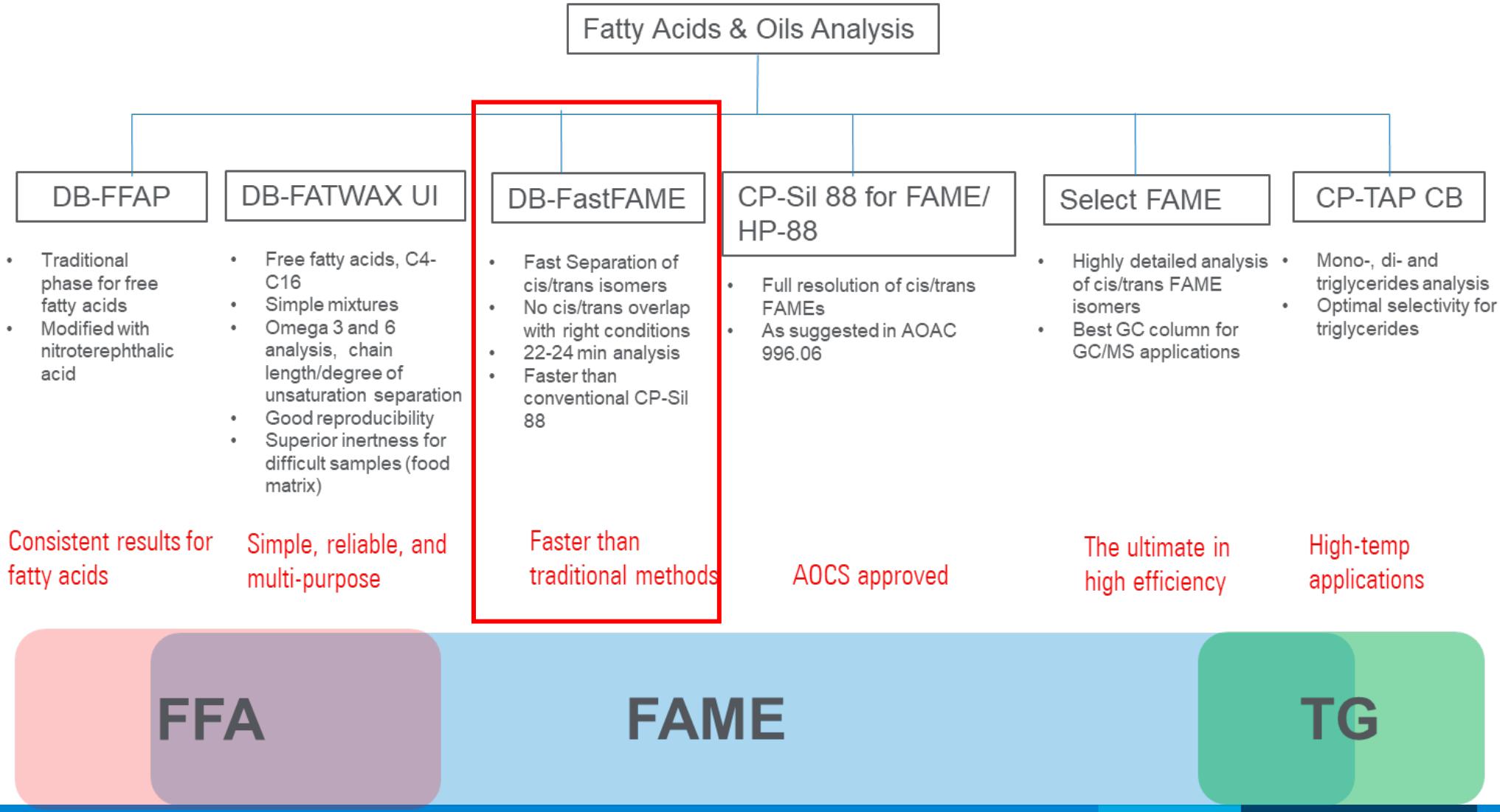
AOAC/AOCS regulatory methods using acid/basic hydrolysis and a possible methylation to form FAMEs

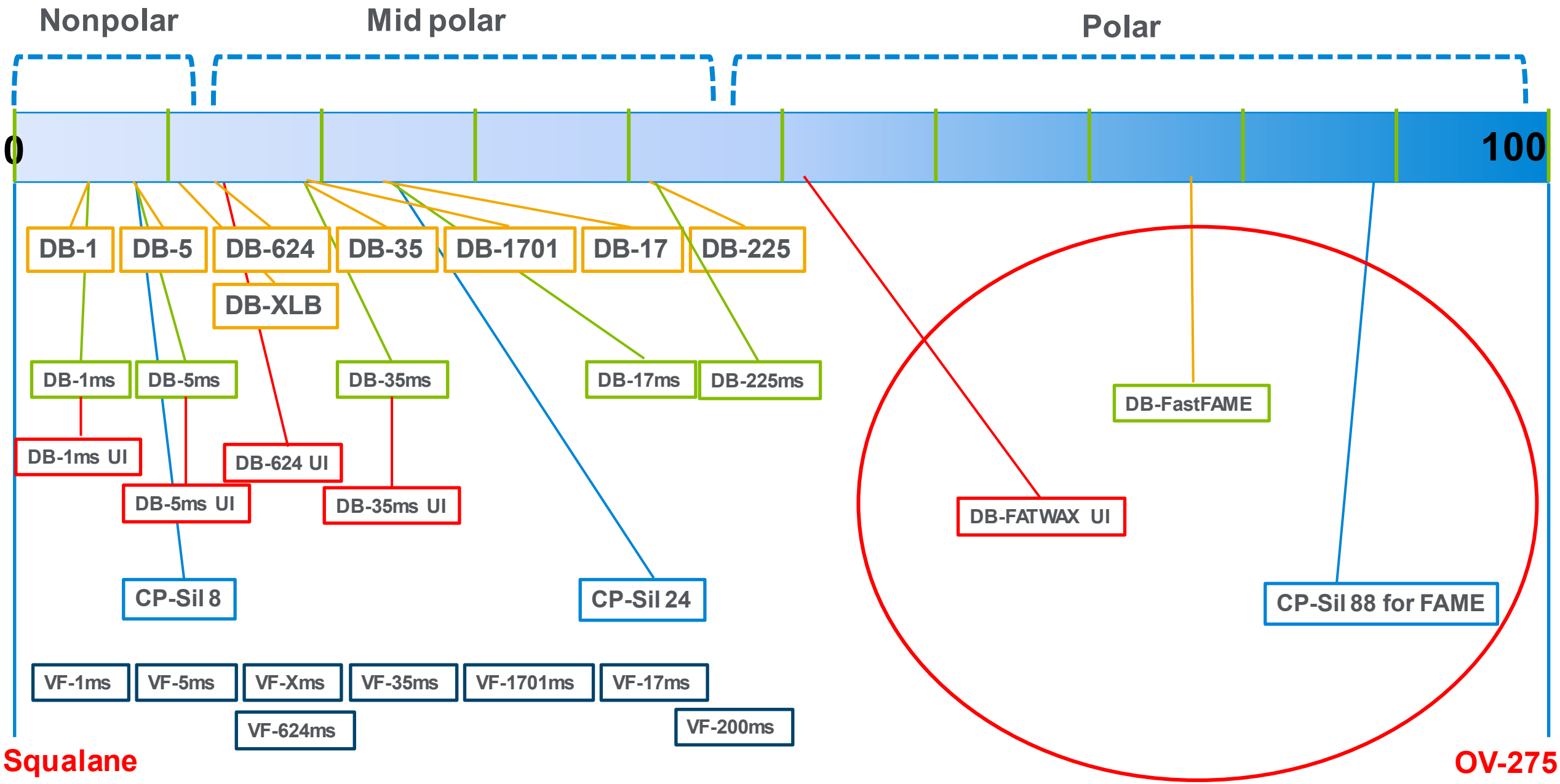
DB-FATWAX UI which offers superior inertness for free fatty acid analysis and the **DB-FastFAME,** designed to offer faster analysis times and improve throughput.

These fatty acid/FAME molecules can have the same mass but have different structures. MS cannot tell them apart. **FID > MS**

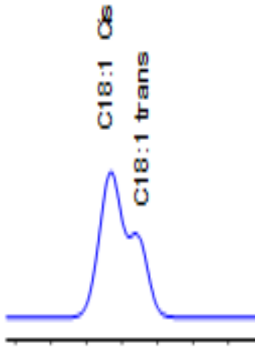
The critical step in the analysis of FAMEs that will ensure consistent results is the GC column

Comprehensive Portfolio for Fatty Acids, FAME, and Oils Analysis



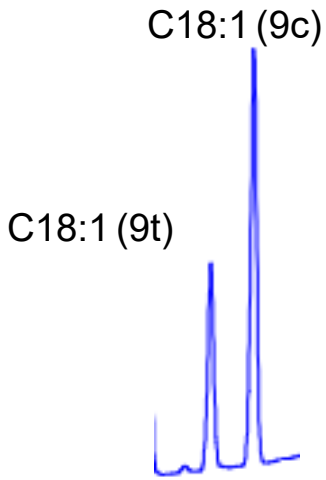

Nonpolar
Mid polar
Polar
0
100
DB-1
DB-5
DB-624
DB-35
DB-1701
DB-17
DB-225
DB-XLB
DB-1ms
DB-5ms
DB-35ms
DB-17ms
DB-225ms
DB-1ms UI
DB-624 UI
DB-5ms UI
DB-35ms UI
CP-Sil 8
CP-Sil 24
DB-FastFAME
DB-FATWAX UI
CP-Sil 88 for FAME
VF-1ms
VF-5ms
VF-Xms
VF-35ms
VF-1701ms
VF-17ms
VF-624ms
VF-200ms
Squalane
OV-275

Column Polarity/Interaction Effects – FAMEs

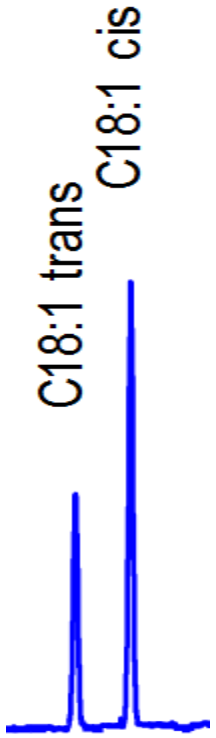


DB-FATWAX UI

DB-FastFAME, 30 m



DB-FastFAME, 90 m



CP-Sil 88 FAME

Traditional GC Columns

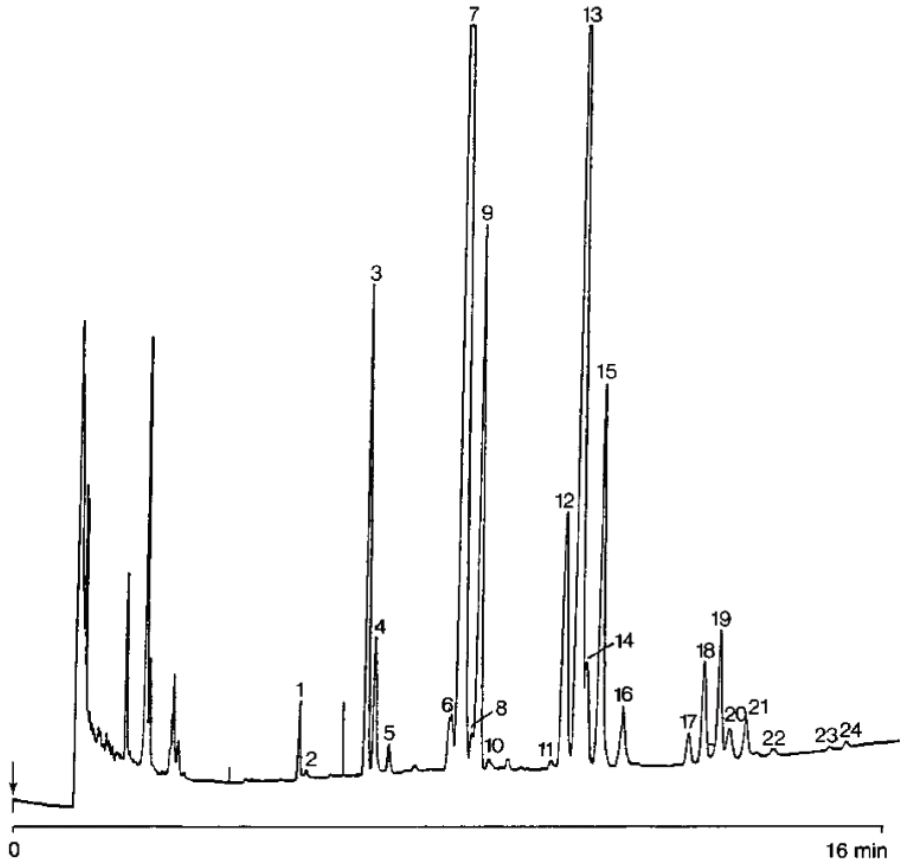
For fatty acids, FAMEs and triglycerides

Triglycerides Analysis of Palm Oil

CP-TAP CB for triglycerides

Column	**CP-TAP CB**, 25 m, 0.25 mm, 0.10 µm (p/n CP7483)
Inlet	Oncolumn
Carrier	Hydrogen, 100 kPa (1 bar, 15 psi)
Oven	340 ºC (1 min) to 355 ºC at 1 ºC/min
Detector	FID
Injection	0.2 µL
Sample	0.05% palm oil in hexan

		Carbon No.
1.	MPP	46
2.	MOM	46
3.	PPP	48
4.	MOP	48
5.	MLP	48
6.	PPS	50
7.	POP	50
8.	MOO	50
9.	PLP	50
10.	MLO	50
11.	PSS	52
12.	POS	52
13.	POO	52
14.	PLS	52
15.	PLO	52
16.	PLL	52
17.	SOS	54
18.	SOO	54
19.	OOO	54
20.	SLO	54
21.	OLO	54
22.	OLL	54
23.	SOA	56
24.	AOO	56



M: Myristic acid (tetradecanoic acid) C14:0
P: Palmitic acid, (hexadecanoic acid) C16:0
S: Stearic acid (octadecanoic acid) C18:0
O: Oleic acid (cis-9-octadecenoic acid) C18:1
L: Linoleic acid (cis,cis-9,12,octadecadienoic acid) C18:2
A: Arachidic acid (eicosanoic acid) C20:0

Application note: A00195

Analysis of Free Fatty Acids

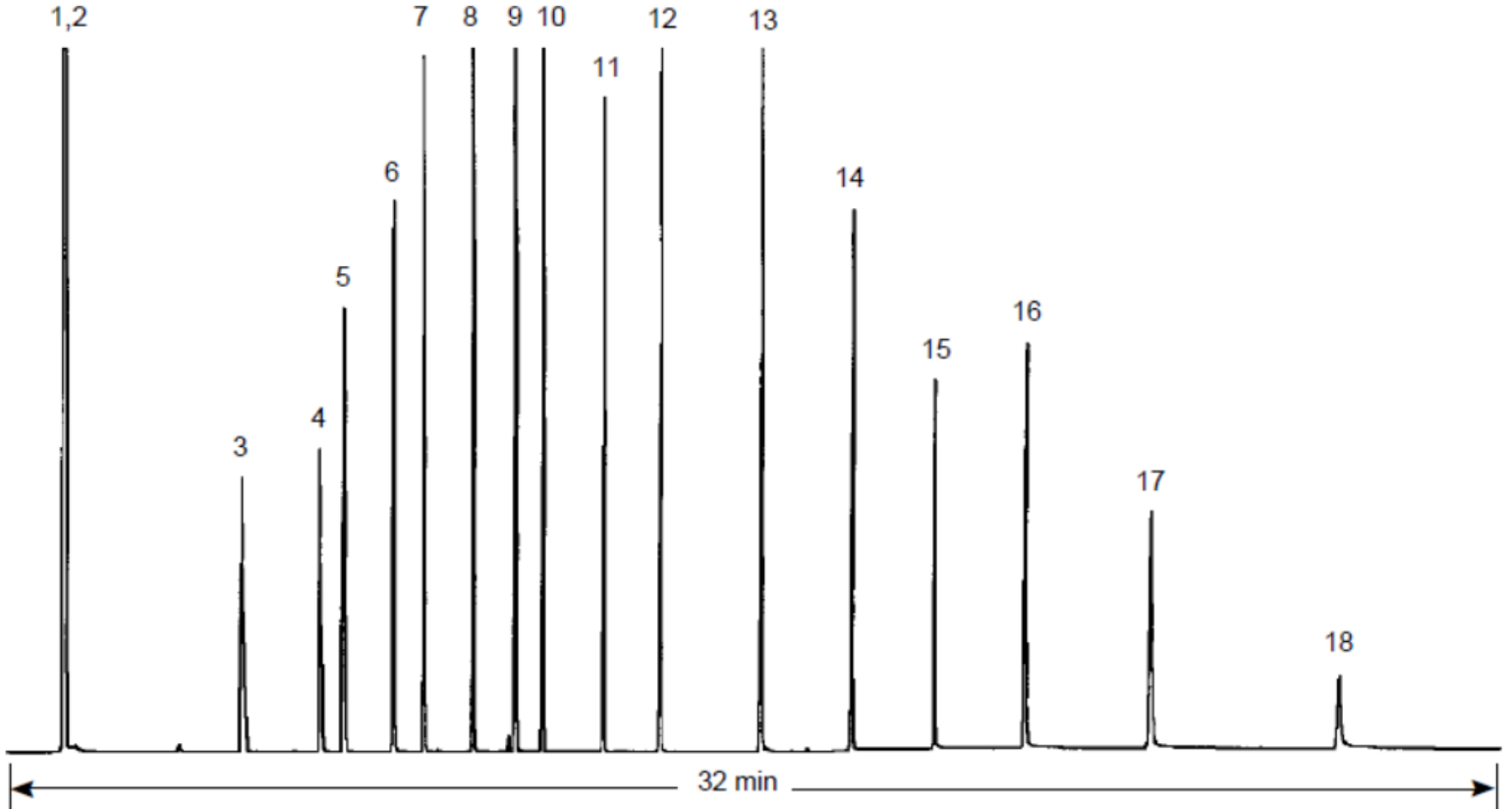
Acid-based WAX: DB-FFAP

Column	**DB-FFAP**, 30 m, 0.25 mm, 0.25 µm (p/n 122-3232)
Carrier	Helium at 40 cm/s, measured at 100 °C
Oven	100 ºC (5 min) to 250 ºC (12 min) at 10 ºC/min
Detector	FID, 300 °C Nitrogen makeup gas at 30 mL/min
Injector	Split 1:50, 250 °C

Chromatogram C077

Peak Number

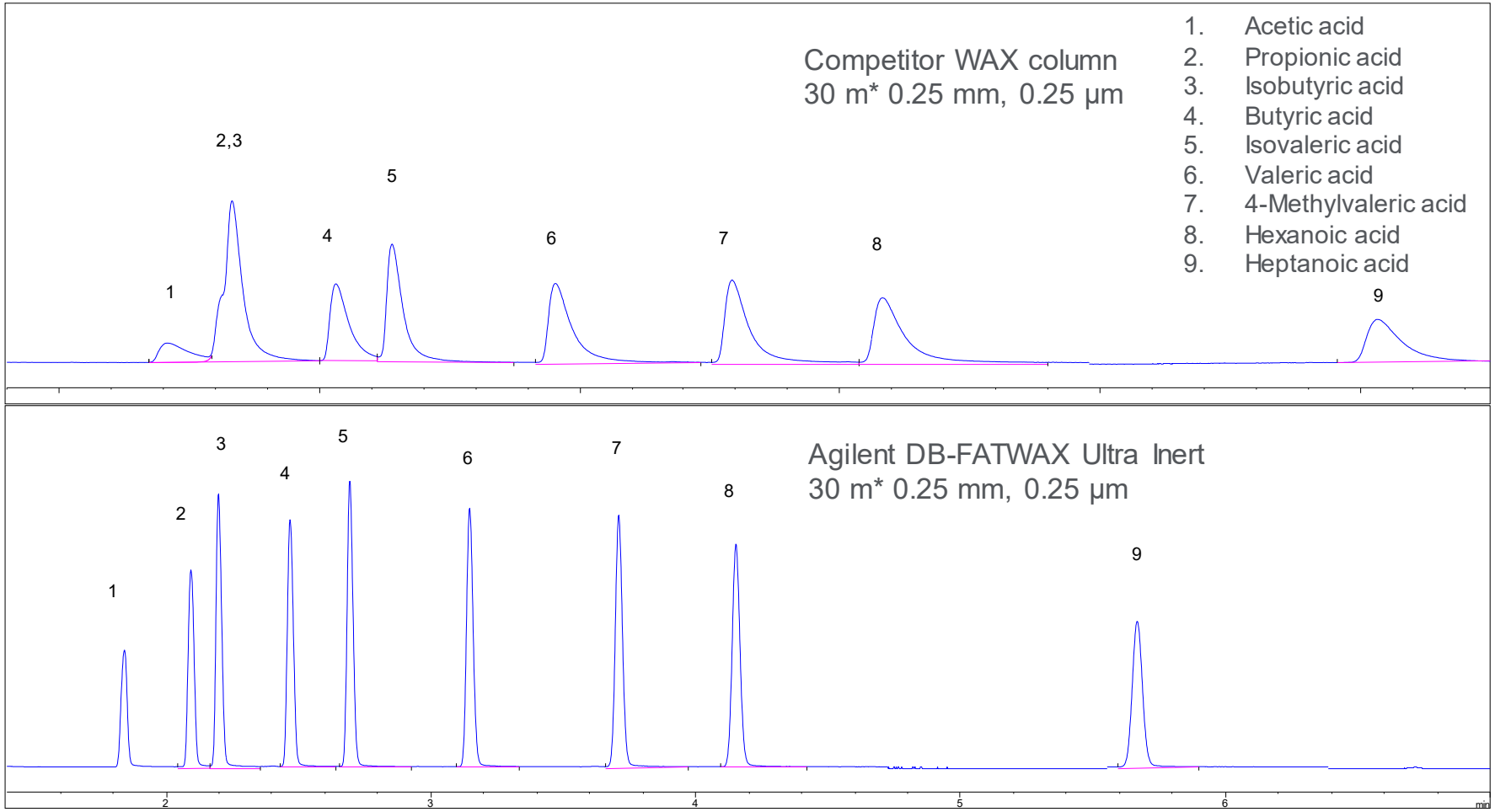
1. Acetone
2. Formic acid
3. Acetic acid
4. Propionic acid
5. Isobutyric acid
6. Butyric acid
7. Isovaleric acid
8. Valeric acid
9. Isocaproic acid
10. Caproic acid
11. Heptanoic acid
12. Octanoic acid
13. Decanoic acid
14. Dodecanoic acid
15. Tetradecanoic acid
16. Hexadecanoic acid
17. Octadecanoic acid
18. Arachidic acid



Separation of Short-Chain Volatile Organic Acids in Water

Using a traditional WAX column and DB-FATWAX Ultra Inert

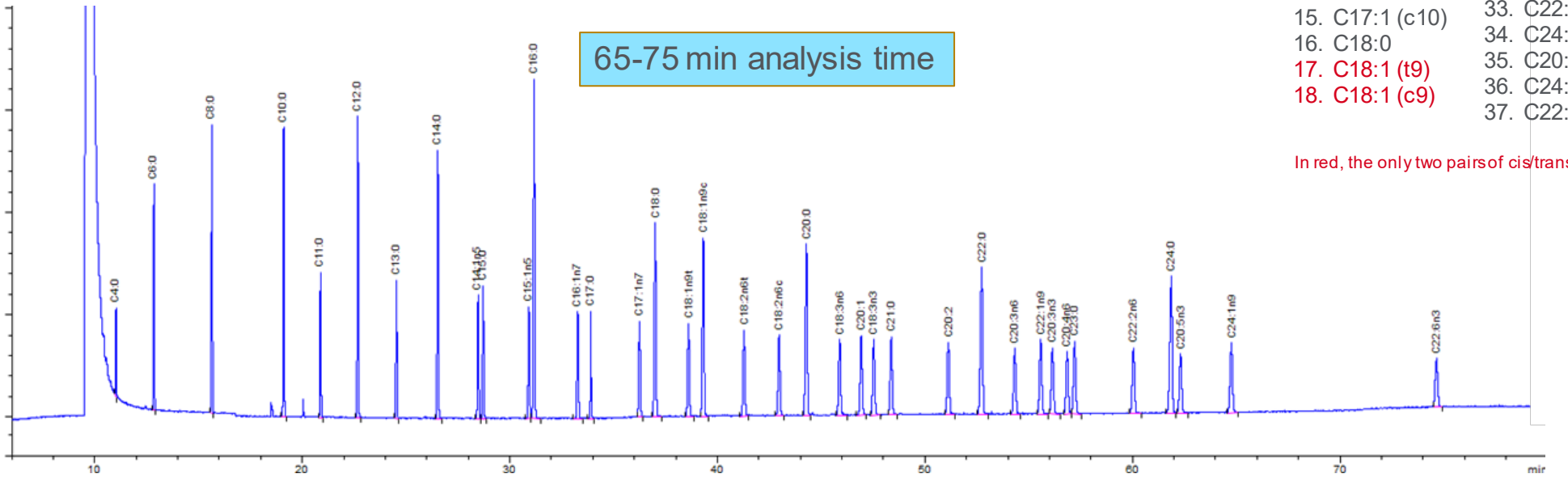
Standard WAX columns don't have the inertness to separate most organic acids



Traditional FAME Analysis on a CP-Sil 88

- Most common method, suggested by AOAC 996.06 and AOCS Ce 1j-07
- Cyanopropyl columns (100 m) are optimized for positional isomer separation of critical cis/trans FAMEs
- Analysis time is typically in the 65 to 76 minute range

FAMES by AOAC 996.06 using traditional 100 m cyanopropylphase



Peak Number

1. C4:0
2. C6:0
3. C8:0
4. C10:0
5. C11:0
6. C12:0
7. C13:0
8. C14:0
9. C14:1 (c9)
10. C15:0
11. C15:1
12. C16:0
13. C16:1 (c9)
14. C17:0
15. C17:1 (c10)
16. C18:0
17. C18:1 (t9)
18. C18:1 (c9)
19. C18:2 (t9, t12)
20. C18:2 (c9, c12)
21. C20:0
22. C18:3 (c6,c9,c12)
23. C20:1 (c11)
24. C18:3 (c9, c12, c15)
25. C21:0
26. C20:2 (c11, c14)
27. C22:0
28. C20:3 (c8, c11, c14)
29. C22:1 (c13)
30. C20:3 (c11, c14, c17)
31. C23:0
32. C20:4 (c5,c8,c11,c14)
33. C22:2 (c13, c16)
34. C24:0
35. C20:5 (c5,c8,c11,c14,c17)
36. C24:1 (c15)
37. C22:6 (c4,c7,c10,c13,c16,c19)

In red, the only two pairs of cis/trans isomers

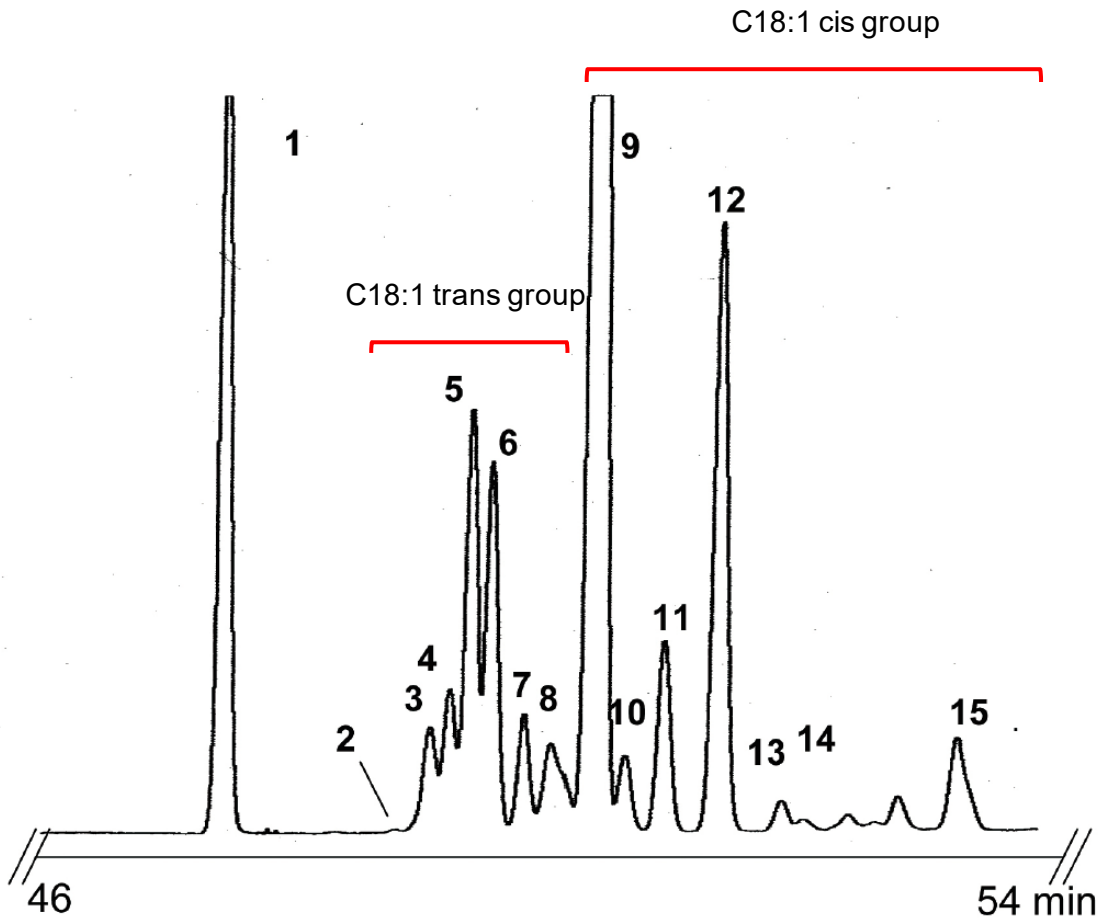
Detailed Analysis of Cis/Trans FAMEs C18:1 Positional Isomers

Column	**Select FAME,** 200 m, 0.25 mm id (p/n CP7421)
Inlet	250 °C, split mode, split ratio 1:20
Carrier	Helium, 520 kPa
Oven	185 °C
FID	250 °C
Injection	0.5 µL

Select-FAME

Peak Number

1. C18:0
2. C18:1 7 trans
3. C18:1 8 trans
4. C18:1 9 trans
5. C18:1 10 trans
6. C18:1 11 trans
7. C18:1 12 trans
8. C18:1 trans + ?
9. C18:1 9 cis
10. C18:1 10 cis
11. C18:1 11 cis
12. C18:1 12 cis
13. C18:1 13 cis
14. C18:1 14 cis
15. C18:1 15 cis



Introducing High-Resolution DB-FastFAME

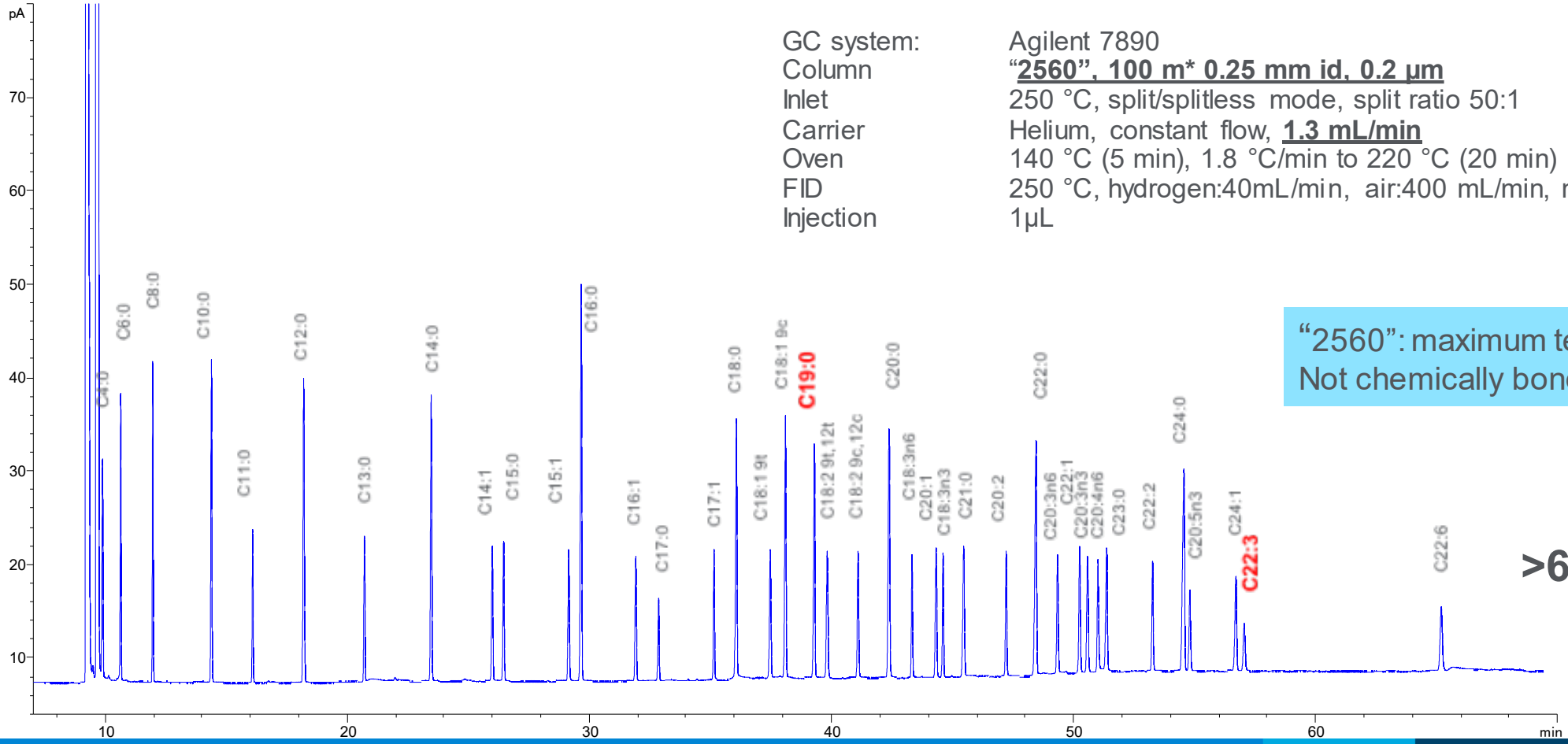
- Fast separation of cis/trans isomers
- No cis/trans overlap with right conditions
- 22 to 24 minute analysis (<37 FAMES)

- Faster than conventional 88-type columns
- Improve throughput
- Reduced column cost
- Reduced run time
- Improved column longevity/durability

Traditional FAME Analysis on “2560” Column

- 37-FAME mix plus C19:0 and C22:3
- Analysis time is typically in the 65 to 76 min range, following AOAC 996.02 method
- Cyanopropyl column (100 m) is the ‘go-to’ column for positional cis/trans isomers

GC system:	Agilent 7890
Column	“**2560”, 100 m* 0.25 mm id, 0.2 µm**
Inlet	250 °C, split/splitless mode, split ratio 50:1
Carrier	Helium, constant flow, **1.3 mL/min**
Oven	140 °C (5 min), 1.8 °C/min to 220 °C (20 min)
FID	250 °C, hydrogen:40mL/min, air:400 mL/min, makeup gas: 25mL/min
Injection	1µL

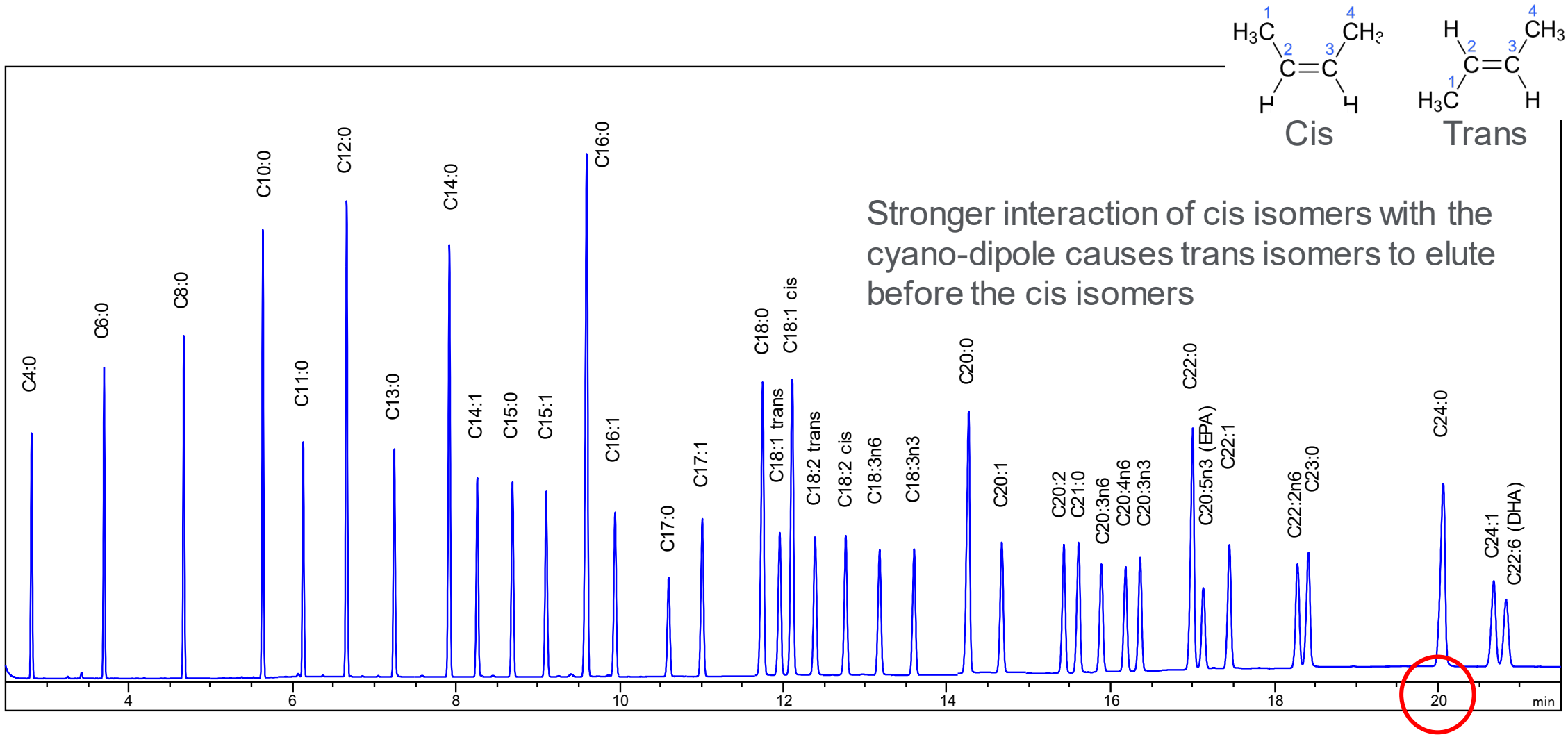


“2560”: maximum temperature is 250 °C
Not chemically bonded

>65 min

DB-FastFAME (30 m x 0.25 mm x 0.25 µm)

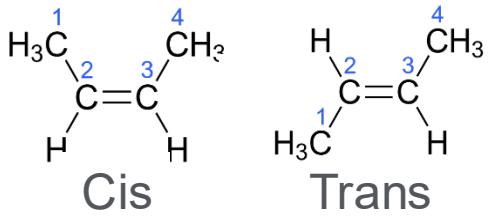
Technical note 5991-8706EN



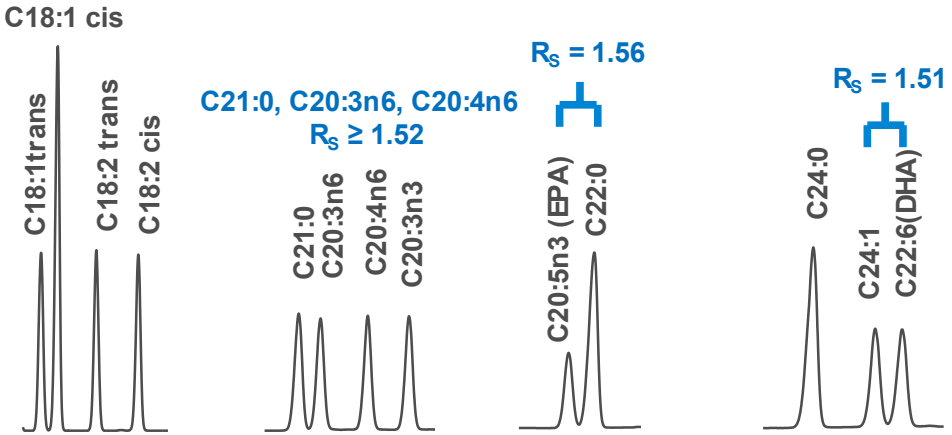
DB-FastFAME
20 m x 0.18 mm x 0.20 µm

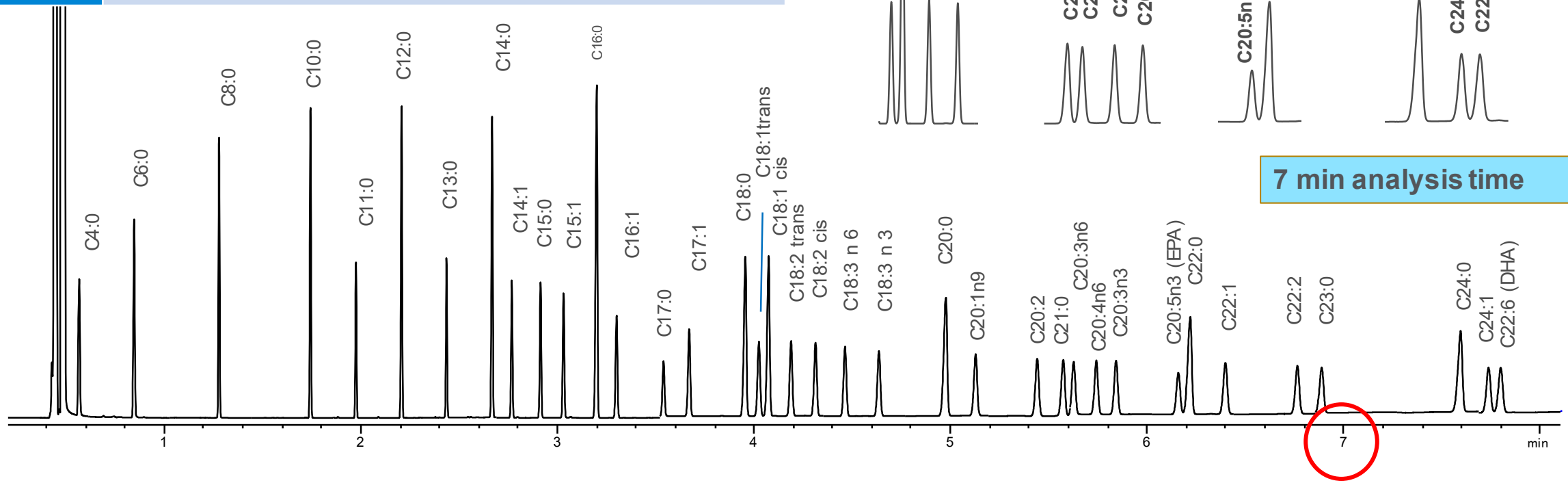
Column	Agilent J&W DB-FastFAME, 20 m x 0.18 mm, 0.20 µm
Gas	**Hydrogen**, 28 psi, constant pressure mode
Inlet	Split/splitless, 250 °C, split ratio 50:1
Oven	80 °C (0.5 min), **65 °C/min** to 175 °C, 10 °C/min to 185 °C (0.5 min), 7 °C/min to 230 °C
FID	280 °C, hydrogen: 40 mL/min; air: 400 mL/min; makeup gas: 25 mL/min.
Injection	1 µL

Strong interaction between cis isomers and the dipoles of the cyanopropyl ligands. This allows the trans to elute after the cis isomers.



$R_S \geq 1.95$ for cis/trans isomers





7 min analysis time

Agilent Intuvo 9000

- New design
- New column connection
- Guard chip
- New column heating
- Application to FAME analysis

Intelligent, intuitive, innovative. Intuvo.

Innovating a New Path to GC Productivity

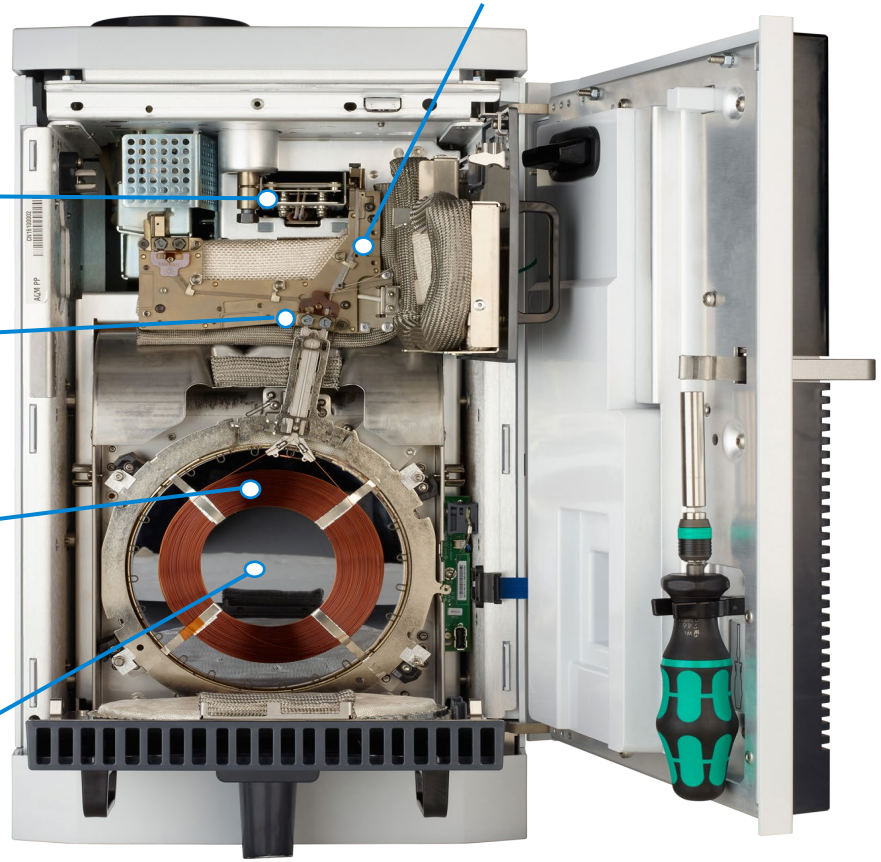
Disposable Guard chip

Ferrule-free click-and-run connections

No-trim column

Direct heating

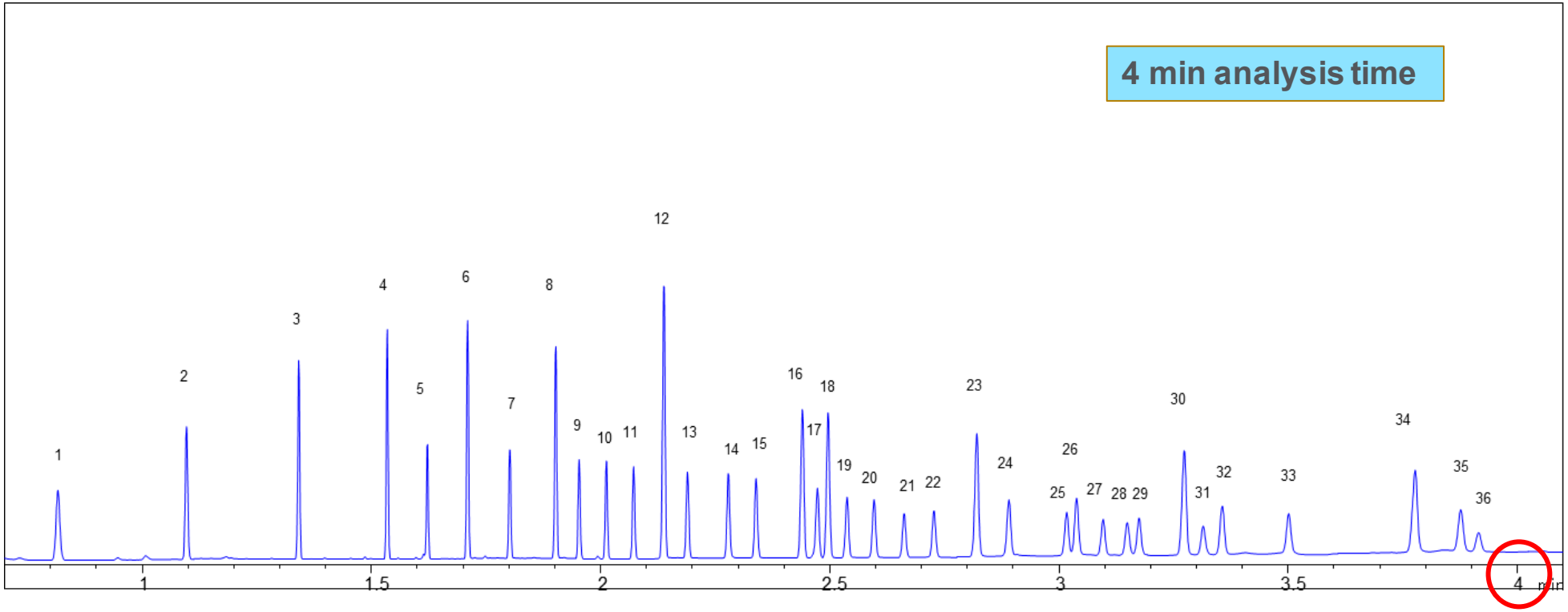
Modular Intuvo flow chips



Fast Analysis of a 36-FAME Mix (AOAC 2012.13)

With the Intuvo 20-m DB-FastFAME

GC system:	Agilent Intuvo 9000 GC system
Column	DB-FastFAME, 20 m* 0.18 mm id, 0.20 µm, Intuvo module
Inlet	250 °C, split/splitless mode, split ratio 100:1
Intuvo Guard chip	200 °C
Carrier	**Hydrogen**, constant pressure, 28 psi
Oven	50 °C (0.3 min), 200 °C/min to 200 °C (0.4 min), 20 °C/min to 240 °C (1 min)
FID	260 °C, hydrogen:40 mL/min, air: 400 mL/min, makeup gas: 25 mL/min
Injection	1 µL



Agilent CrossLab
From Insight to Outcome

How About More Complex FAME Samples like PHVO?

New high-resolution DB-FastFAME GC columns

Agilent

New Agilent J&W DB-FastFAME High-Resolution GC Columns

Highlights

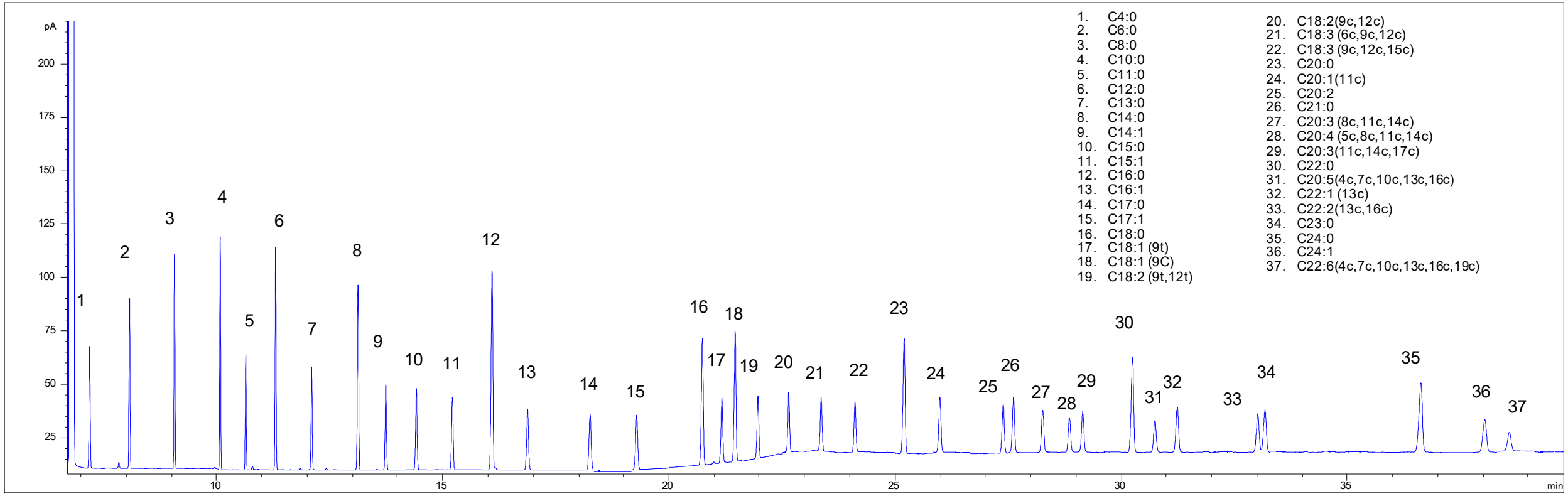
- The new 90-meter DB-FastFAME separates complex positional cis/trans FAME isomers with similar or better resolution than SP-2560, in <48 minutes
- A 60-meter DB-FastFAME is available for less demanding separations, and Intuvo applications
- Resolves critical fatty acids in food samples, making it easy to comply with labeling requirements
- Provides increased thermal stability and extend column lifetime over nonbonded cyano phases
- Same micro-union developed for Intuvo is used to assemble the 90-meter DB-FastFAME

37-Component FAMEs Standard Mixture on a DB-FastFAME GC Column

Under 40 minutes

GC system:	Agilent 8890
Column	DB-FastFAME, 90 m* 0.25 mm id, 0.25 µm (p/n G3903-63013Z,s/n T009721Z)
Inlet	260 °C, split/splitless mode, split ratio 50:1
Carrier	Helium, constant pressure 48 psi
Oven	80 °C (1 min), 40 °C/min to 200 °C (15 min), 10 °C/min to 235 °C (25 min)
FID	260 °C, hydrogen: 30 mL/min, air: 300 mL/min, makeup gas: 25 mL/min
Injection	1 µL

Application Note: 5994-1862EN



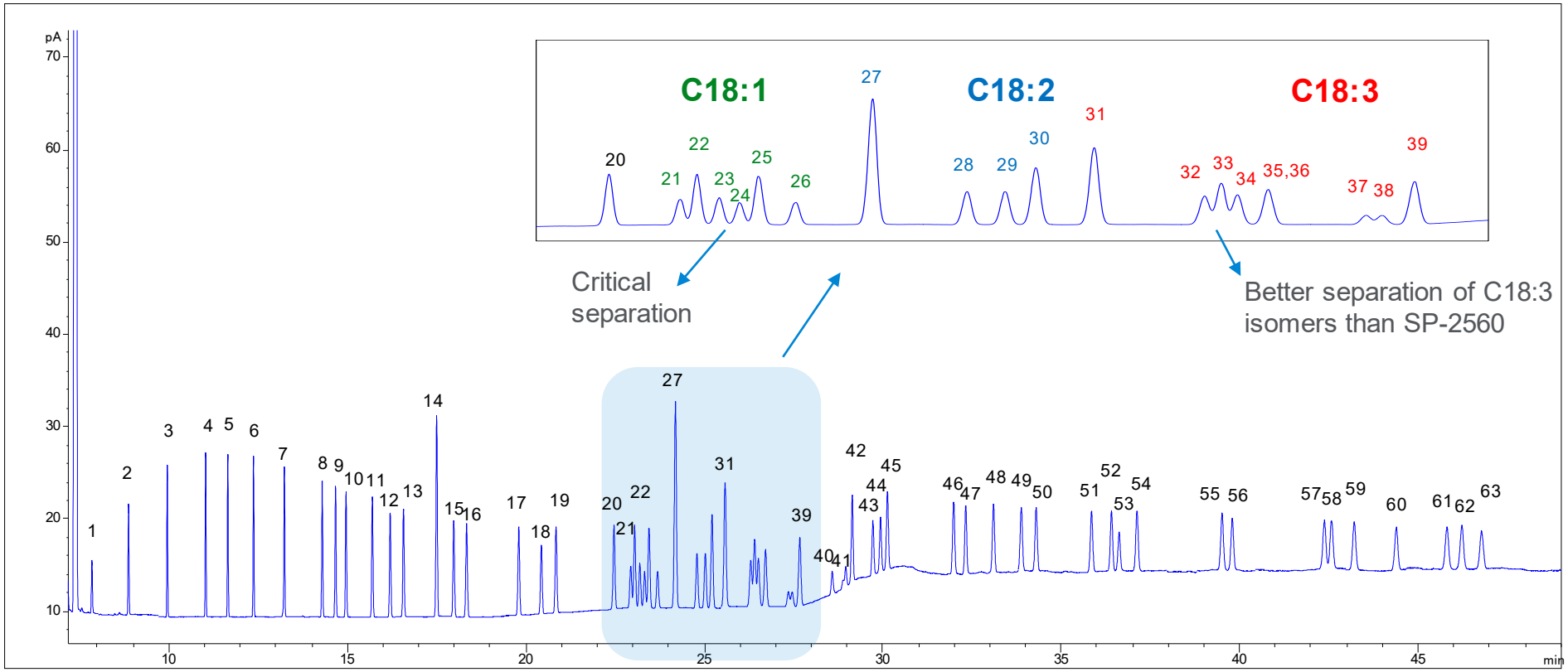
1. C4:0
2. C6:0
3. C8:0
4. C10:0
5. C11:0
6. C12:0
7. C13:0
8. C14:0
9. C14:1
10. C15:0
11. C15:1
12. C16:0
13. C16:1
14. C17:0
15. C17:1
16. C18:0
17. C18:1 (9t)
18. C18:1 (9C)
19. C18:2 (9t,12t)
20. C18:2(9c,12c)
21. C18:3 (6c,9c,12c)
22. C18:3 (9c,12c,15c)
23. C20:0
24. C20:1(11c)
25. C20:2
26. C21:0
27. C20:3 (8c,11c,14c)
28. C20:4 (5c,8c,11c,14c)
29. C20:3(11c,14c,17c)
30. C22:0
31. C20:5(4c,7c,10c,13c,16c)
32. C22:1 (13c)
33. C22:2(13c,16c)
34. C23:0
35. C24:0
36. C24:1
37. C22:6(4c,7c,10c,13c,16c,19c)

63-Component FAME Mixture Analysis

In <48min using a 90m x 0.25mm DB-fastFAME column

GC system:	Agilent 8890
Column	DB-FastFAME, 90 m* 0.25 mm id, 0.25 µm (p/n G3903-63013Z,s/n T009721Z)
Inlet	260 °C, split/splitless mode, split ratio 30:1
Carrier	Helium, constant pressure 44 psi
Oven	75 °C (1 min), 35 °C/min to 200 °C (14 min), 2.5 °C/min to 210 °C (5 min), 12 °C/min to 230 °C (20 min)
FID	260 °C, hydrogen: 30 mL/min, air: 300 mL/min, makeup gas: 25 mL/min
Injection	1 µL

- Separation of critical C18:1 isomers
- R_S of C18:1 (11t)/c18:1(6c) >1.40 (baseline resolution)
- Separation of C18:2 isomers
- Separation of C18:3 isomers except for one pair (same as SP-2560)
- Analysis time <48min



Application Note: 5994-1862EN

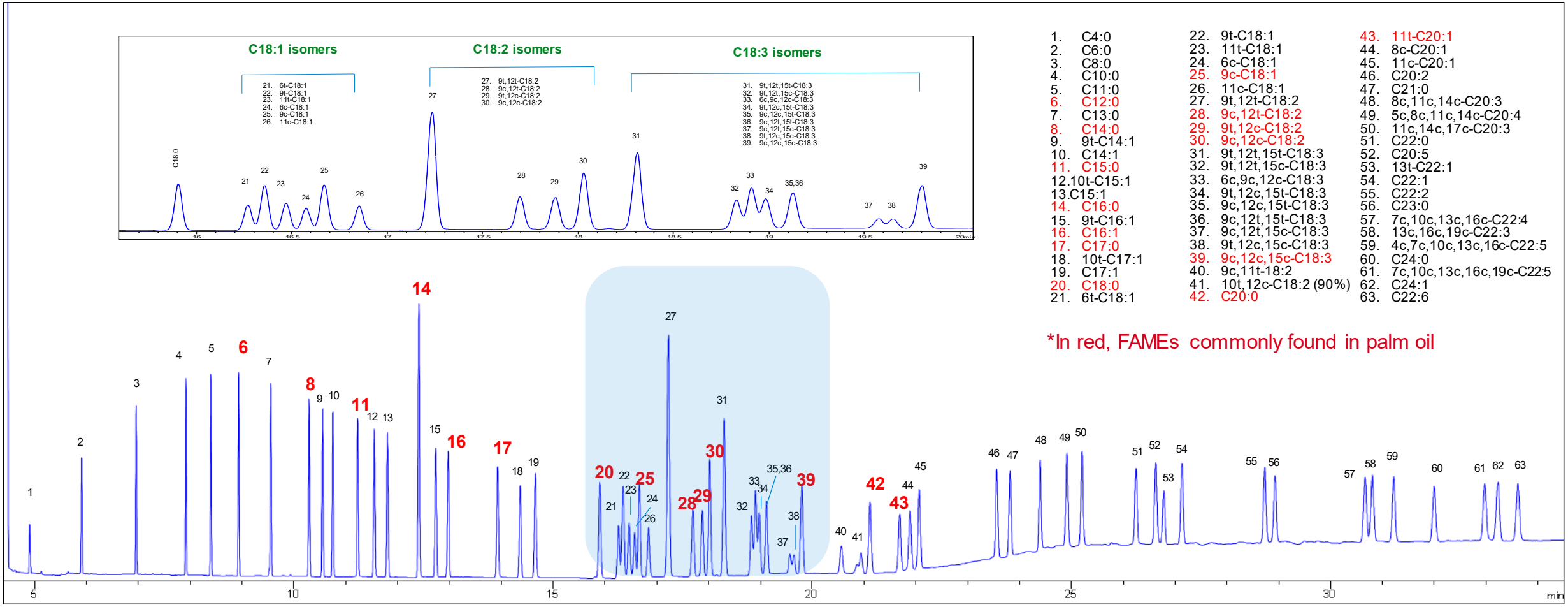
1. C4:0
2. C6:0
3. C8:0
4. C10:0
5. C11:0
6. C12:0
7. C13:0
8. C14:0
9. C14:1(9t)
10. C14:1
11. C15:0
12. C15:1
13. C15:1 (10t)
14. C16:0
15. C16:1 (9t)
16. C16:1
17. C17:0
18. C17:1(10t)
19. C17:1
20. C18:0
21. C18:1(6t)
22. C18:1 (9t)
23. C18:1 (11t)
24. C18:1 (6C)
25. C18:1 (9C)
26. C18:1 (11C)
27. C18:2 (9t,12t)
28. C18:2(9c,12t)
29. C18:2 (9t,12c)
30. C18:2(9c,12c)
31. C18:3 (9t,12t,15t)
32. C18:3 (9t,12t,15c)
33. C18:3 (6c,9c,12c)
34. C18:3 (9t,12c,15t)
35. C18:3 (9c,12c,15t)
36. C18:3 (9c,12t,15t)
37. C18:3 (9c,12t,15c)
38. C18:3 (9t,12c,15c)
39. C18:3 (9c,12c,15c)
40. C18:2 (t9,c11)
41. C18:2 (t10,c12) (90%)
42. C20:0
43. C20:1(11t)
44. C20:1(8c)
45. C20:1(11c)
46. C20:2
47. C21:0
48. C20:3 (8c,11c,14c)
49. C20:4 (5c,8c,11c,14c)
50. C20:3(11c,14c,17c)
51. C22:0
52. C20:5(4c,7c,10c,13c,16c)
53. C22:1 (13t)
54. C22:1 (13c)
55. C22:2(13c,16c)
56. C23:0
57. C22:4(7c,10c,13c,16c)
58. C22:3(13c,16c,19c)
59. C22:5 (4c,7c,10c,13c,16c)
60. C24:0
61. C22:5 (7c,10c,13c,16c,19c)
62. C24:1
63. C22:6(4c,7c,10c,13c,16c,19c)

GC/FID Chromatogram of 63-Component FAMEs Standard Mixture

On an Agilent J&W DB-FastFAME column using **hydrogen** as carrier gas

<40 min

Application note: 5994-1862EN

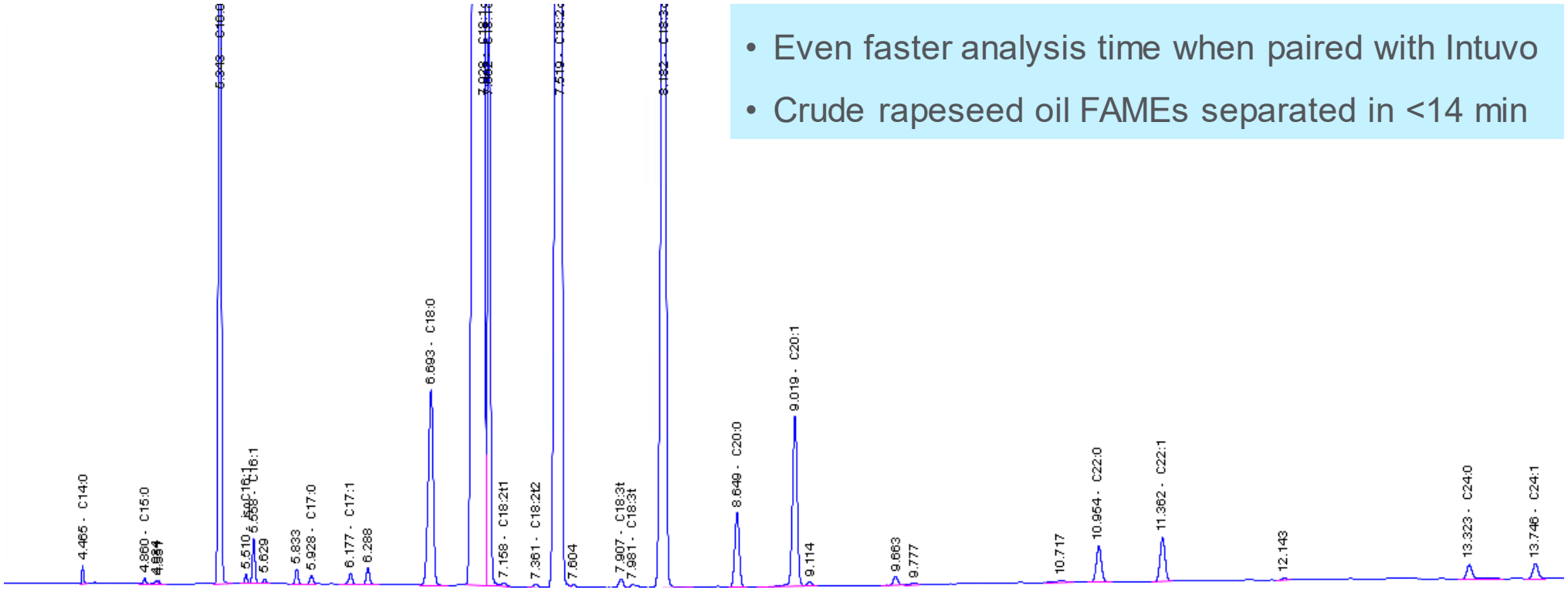


1. C4:0
2. C6:0
3. C8:0
4. C10:0
5. C11:0
6. C12:0
7. C13:0
8. C14:0
9. 9t-C14:1
10. C14:1
11. C15:0
12. 10t-C15:1
13. C15:1
14. C16:0
15. 9t-C16:1
16. C16:1
17. C17:0
18. 10t-C17:1
19. C17:1
20. C18:0
21. 6t-C18:1
22. 9t-C18:1
23. 11t-C18:1
24. 6c-C18:1
25. 9c-C18:1
26. 11c-C18:1
27. 9t,12t-C18:2
28. 9c,12t-C18:2
29. 9t,12c-C18:2
30. 9c,12c-C18:2
31. 9t,12t,15t-C18:3
32. 9t,12t,15c-C18:3
33. 6c,9c,12c-C18:3
34. 9t,12c,15t-C18:3
35. 9c,12c,15t-C18:3
36. 9c,12t,15t-C18:3
37. 9c,12t,15c-C18:3
38. 9c,12c,15c-C18:3
39. 9c,12c,15c-C18:3
40. 9c,11t-18:2
41. 10t,12c-C18:2 (90%)
42. C20:0
43. 11t-C20:1
44. 8c-C20:1
45. 11c-C20:1
46. C20:2
47. C21:0
48. 8c,11c,14c-C20:3
49. 5c,8c,11c,14c-C20:4
50. 11c,14c,17c-C20:3
51. C22:0
52. C20:5
53. 13t-C22:1
54. C22:1
55. C22:2
56. C23:0
57. 7c,10c,13c,16c-C22:4
58. 13c,16c,19c-C22:3
59. 4c,7c,10c,13c,16c-C22:5
60. C24:0
61. 7c,10c,13c,16c,19c-C22:5
62. C24:1
63. C22:6

*In red, FAMEs commonly found in palm oil

Crude Rapeseed Oil FAMEs with Intuvo 60 m DB-FastFAME GC column

Column	DB-FastFame, 60 m* 0.25 mm id, 0.25 µm (p/n G3909-63007)
Inlet	250 °C, split mode, split ratio 100:1
Guard Chip	SSL guard chip in track oven mode
Carrier	Hydrogen, constant flow mode,50 cm/s avg linear velocity
Oven	120 °C (1 min), 100 °C/min to 200 °C (5 min), 5 °C/min to 240 °C
FID	250 °C, hydrogen: 40 mL/min, air: 400 mL/min, makeup gas: 25 mL/min
Injection	1 µL



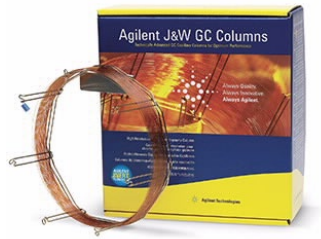
- Even faster analysis time when paired with Intuvo
- Crude rapeseed oil FAMEs separated in <14 min

The High-Resolution Columns are a DB-FastFAME Product Line Extension

DB-FastFAME Product Line	Features and Benefits	Applications
20 m x 0.18 mm x 0.20 µm, 7 in cage and Intuvo	Faster separation of FAMEs than any other column on the market	Simpler FAME mixture (<37 FAMEs) in 8 minutes (for example, vegetable and extra virgin oils)
30 m x 0.25 mm x 0.25 µm, 7 in cage and Intuvo	Good balance between speed and capacity	Simpler FAME mixture (<37 FAMEs) in 25 minutes (for example, vegetable and extra virgin oils)
60 m x 0.25 mm x 0.25 µm, 7 in cage and Intuvo	Ideal for specific FAME applications (CLAs, C18:1 groups, C18:3 groups), and Intuvo applications	Intuvo applications CLA isomers per new GB method 55 FAMEs <38 minutes
90 m x 0.25 mm x 0.25 µm, 7 in cage only	High detail analysis of positional cis/trans isomers with 30-35% faster analysis time than SP-2560	All purpose FAME column (milk fat, cooking oil, trans fats) 63 FAMEs <48 minutes

Workflow

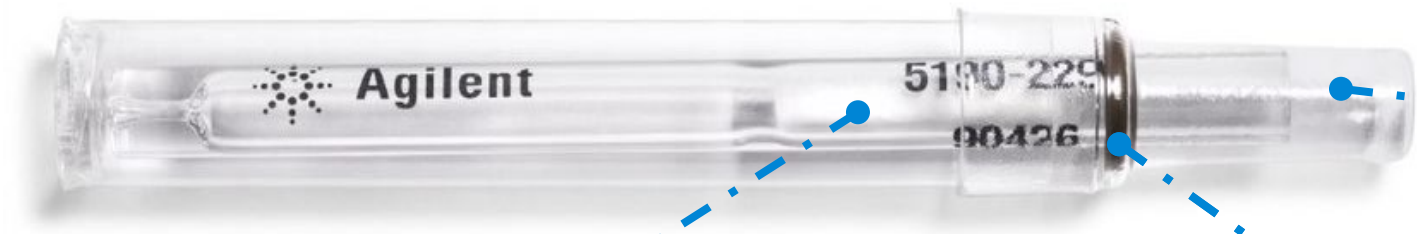
Sample containment	Sample preparation	Standards	Instrument supplies	Separation
Vials and closures	Mostly regulatory methods	FAME MIX 36 FAME C4 – C24 rapeseed oil	GC Inlet UI products Inert flow path Gas Clean filters Intuvo	DB-FATWAX UI DB-FastFAME



Sample Introduction is a Critical Step in FAME Analysis

Most FAMEs and FFA methods use split injection

- Potential exists for sample discrimination between low and high boiling components
  - Leads to poor precision and accuracy
  - FAMEs → varying carbon chain length → various boiling points
  - Using a **split** liner with wool is important (do **not** use a splitless liner)
  - **Ultra Inert** liners enable excellent peak shapes for tricky analytes like FAMEs and FFAs
- 5190-2295 is a recommended liner



Glass wool plug in upper position wipes needle, avoids sample discrimination → excellent P and A

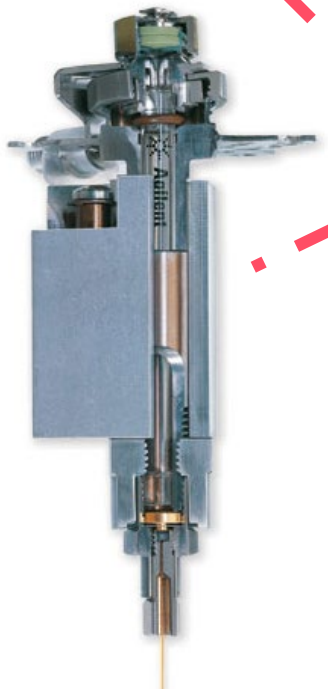
Touchless packaging ensures contamination-free installation

Preinstalled O-ring

Other Opportunities for GC Sample Intro and Supplies

In split analyses, especially high matrix samples, timely replacement of the **split vent trap** is key to avoiding ghost peaks and carryover.

1/pk: 5188-6495 2/pk: G1544-80530



Premium **Blue Line syringes** offer excellent precision and accuracy. Recommend a PTFE tip for high matrix samples.

G4513-80204- 10µL tapered, fixed 23-26s/42/HP
G4513-80203- 10µL tapered, fixed, PTFE tip 23-26s/42/HP

FFAs and FAMEs Product Line Workflow

Sample Containment

- Vials 2 mL
- Amber
- Write on spot
- PTFE/Silcone screw cap
- Standard/ Certified
- UPL
- ValueLab
- Crimpers

Sample Preparation

- AOAC and AOCS regulatory methods
- QuEChERS
- Bond Elut SPE
- Chem Elut
- Captiva EMR-Lipid

Standards

- FAME Mix – 36:
- FAME Mix C4-C24:
- Rapeseed oil

Instrument Supplies/Sample Introduction

- Inlet supplies
  - Liner UI: Split w/ glass wool
  - Septa: BTO
  - Inlet seal: UI
  - Split vent trap
  - Inert flow path
  - Gas Clean filters
  - Intuvo
  - Self tightening nuts
  - Ferrules
  - Syringes

Columns

- DB FATWAX UI GC
- DB FastFame
- Multiple dimension for standard GCs
- Intuvo columns

Regulatory

- AOCS Official Method of Analysis (2000), method Ce 2-66
- IUPAC, Standard methods for Analysis of Oils, Fats and Derivatives, Blackwell Scientific Publications, IUPAC Method 2.301
- AOAC 2012.13
- AOAC 996.06
- AOCS Ce 1-62
- AOCS Ce 1b-89

Applications/ Selection Guides/ User Tools

- Food safety brochures
- FATWAX UI application notes
- FastFAME application notes
- FAME GC brochure

Collateral

LITERATURE	LINK/PUBLICATION NUMBER	
Improving the Analysis of 37 Fatty Acid Methyl Esters: Using Three Types of Capillary Columns	5991-8706EN	Application note
Analysis of Omega 3 and Omega 6 FAMEs in Fish Oil and Animal Fat Using an Agilent J&W DB-FATWAX Ultra Inert GC Column	5991-8744EN	Application note
A comparison study of the analysis of volatile organic acids and fatty acids: Using DB-FATWAX Ultra Inert and other WAX GC columns	5991-9223EN	Application note
Comprehensive Analysis of FAMEs, Fatty Acids and Triglycerides	5991-8763EN	20 page brochure
Fast Analysis of FAMES on the Intuvo 9000	5991-9482EN	Application note
Rapid Separation of Fatty Acid Methyl Esters using DB-FastFAME Intuvo GC columns	5994-0116EN	Application note

Contact Agilent Chemistries and Supplies Technical Support

1-800-227-9770 Option 3, Option 3:

Option 1 for GC and GC/MS columns and supplies

Option 2 for LC and LC/MS columns and supplies

Option 3 for sample preparation, filtration, and QuEChERS

Option 4 for spectroscopy supplies

Option 5 for chemical standards

Available in the USA and Canada 8–5, all time zones

gc-column-support@agilent.com

lc-column-support@agilent.com

spp-support@agilent.com

spectro-supplies-support@agilent.com

chem-standards-support@agilent.com

Thanks for your attention

Any questions?