

Analyzing Fats and Oils by GC



Your Analysis of Oils and Fats!

Edible oils and fats are among the most abundant cooking ingredients in the world, and are an important part of a healthy balanced diet—especially if they are high in omega-6 and omega-3 polyunsaturated fatty acids. Rather than just the total fatty acid compositions, the analysis of individual lipid species within these oils and fats has become increasingly important. Within the last decade, several lipidomic methods have been adapted and applied to the analysis of edible oils and fats.

This guide will cover the “A to Z” of analyzing oils and fats with gas chromatography, with selecting the right GC column for your matrix—by dimension, phase, application, or manufacturer. Continue to find a wide range of application notes for various oil and fat matrices, and finally, we’ll introduce you to the Zebtron™ ZB-FAME GC column created specifically for the analysis of fatty acids, offering a 75% reduction in run times and improved separation of cis/trans FAME isomers—suitable for AOAC, AOCS, and IOC methods.



guarantee

If Phenomenex products in this guide do not provide at least an equivalent separation as compared to other products of the same phase and dimensions, return the product with your comparative data within 45 days for a FULL REFUND.

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Need help? Our GC scientists have wide-ranging and proven experience in oils and fats analysis and lipid testing, including finished products. Phenomenex also offers a wide range of products that target fatty acids, steroids, triglycerides, and other fat components—providing fast analysis, improved resolution, and temperature resistance. www.phenomenex.com/chat.

Food Quality and Flavors GC Applications

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Essential Oils

by GC-MS

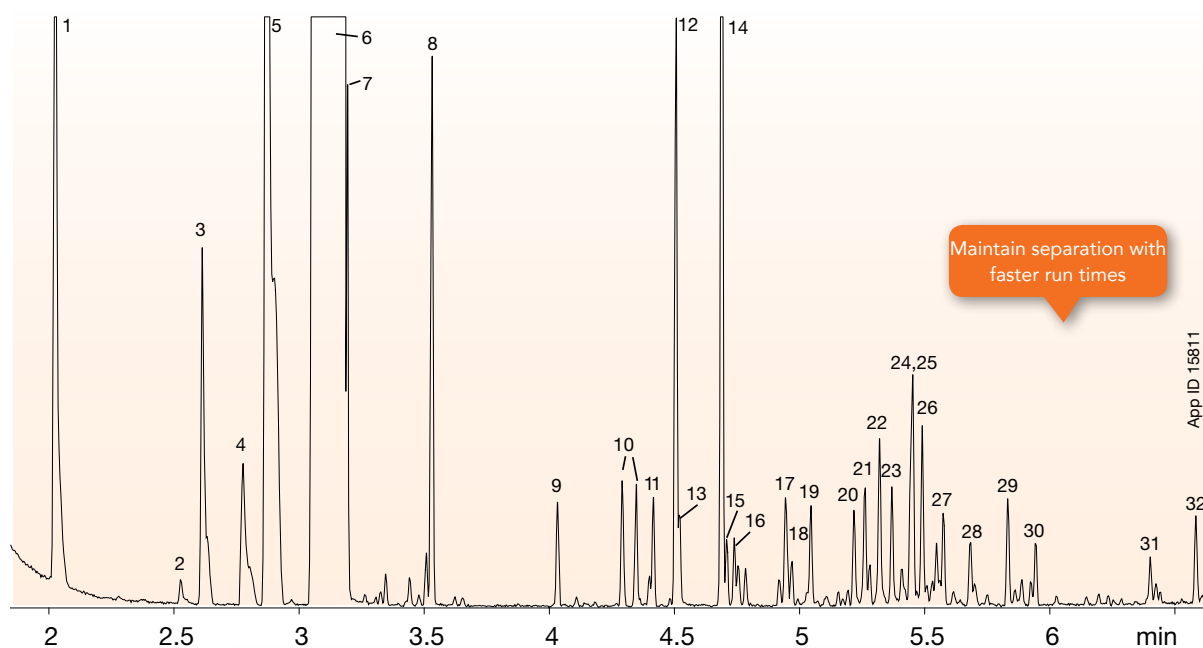
Essential oils are fragrant plant essences primarily composed of terpenes, their derivatives, and other aromatic compounds. Variation in plant locations and growing conditions produces natural differences in essential oil components, and due to their high price, premium oils are subject to adulteration with cheaper terpenes or poorer quality oils. Therefore, characterization of essential oils is necessary, but testing is complex due to the number of compounds and their trace level presence. Runs under seven minutes can be achieved using efficient column dimensions, as demonstrated below.

Cold-Pressed Orange Oil

Column: Zebtron™ ZB-WAX_{PLUS}™
Dimensions: 10 meter x 0.10 mm x 0.10 μm
Part No.: 7CB-G013-02
Injection: Split 20:1 @ 220 °C, 0.2 μL
Carrier Gas: Helium @ 0.3 mL/min (constant flow)
Oven Program: 35 °C for 1 min to 250 °C @ 30 °C/min for 5 min
Detector: MSD; 45-450 amu
Recommended Liner: Zebtron PLUS Single Taper Z-Liner™
Liner Part No.: AG2-0A13-05 (for systems Agilent®)

Sample:

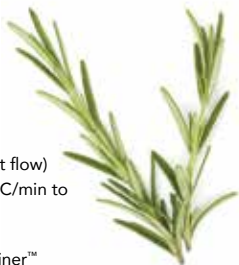
1. α-Pinene
2. β-Pinene
3. Sabinene
4. 3-Carene
5. β-Myrcene
6. Limonene
7. β-Phellandrene
8. Octanal
9. Nonanal
10. Limonene Oxides
11. Citronellal
12. Decanal
13. α-Cubebene
14. Linalool
15. β-Cubebene
16. Octanol
17. Germacrene
18. Caryophyllene
19. trans-p-Mentha-2,8-dienol
20. cis-p-Mentha-2,8-dienol
21. Geraniol
22. α-Terpineol
23. Dodecanal
24. Valencene
25. Citral
26. Carvone
27. Cadinene
28. Perillaldehyde
29. trans-Carveol
30. cis-Carveol
31. Perillol
32. Octanoic Acid



Essential Oils

by GC-MS

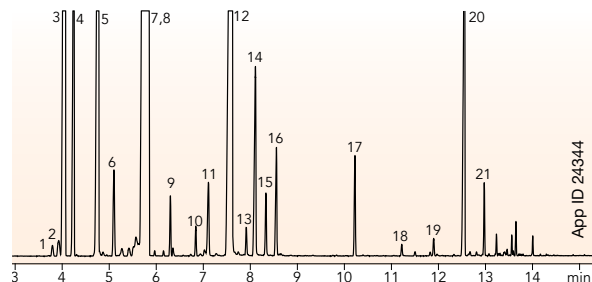
Rosemary Oil



Column: Zebron™ ZB-1PLUS
Dimensions: 10 meter x 0.10 mm x 0.10 μm
Part No.: 7CB-G031-02
Injection: Split 120:1 @ 160 °C, 0.2 μL
Carrier Gas: Helium @ 0.4 mL/min (constant flow)
Oven Program: 45 °C for 2 min to 130 °C @ 8 °C/min to 200 °C @ 30 °C/min for 2 min
Detector: MSD; 18-400 amu
Recommended Liner: Zebron PLUS Single Taper Z-Liner™
Liner Part No.: AG2-0A13-05 (for Agilent® System)

Sample: Sample was 10% in dichloromethane

- | | | |
|---------------|-----------------|---------------------|
| 1. Tricyclene | 8. Limonene | 15. 4-Terpeneol |
| 2. α-Thujene | 9. γ-Terpinene | 16. Terpineol |
| 3. α-Pinene | 10. Terpinolene | 17. Bornyl Acetate |
| 4. Camphene | 11. Linalool | 18. Eugenol |
| 5. β-Pinene | 12. Camphor | 19. Copaene |
| 6. β-Myrcene | 13. Isoborneol | 20. Caryophyllene |
| 7. Eucalyptol | 14. Borneol | 21. α-Caryophyllene |



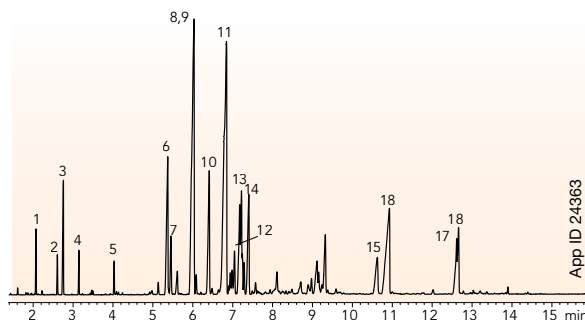
Ylang Ylang Oil



Column: Zebron ZB-1PLUS
Dimensions: 10 meter x 0.10 mm x 0.10 μm
Part No.: 7CB-G031-02
Injection: Split 120:1 @ 160 °C, 0.2 μL
Carrier Gas: Helium @ 0.5 mL/min (constant flow)
Oven Program: 60 °C to 120 °C @ 15 °C/min to 160 °C @ 5 °C/min to 220 °C @ 20 °C/min
Detector: MSD; 18-400 amu
Recommended Liner: Zebron PLUS Single Taper Z-Liner™
Liner Part No.: AG2-0A13-05 (for Agilent® System)

Sample: Oil was 10% in dichloromethane

- | | | |
|---------------------|---------------------|-----------------------|
| 1. p-Methyl Anisole | 7. Copaene | 13. Farnasene |
| 2. Methyl Benzoate | 8. β-Caryophyllene | 14. δ-Cadinene |
| 3. Linalool | 9. Cinnamyl Acetate | 15. Farnesol |
| 4. Benzyl Acetate | 10. Humulene | 16. Benzyl Benzoate |
| 5. Geraniol | 11. Germacrene | 17. Benzyl Salicylate |
| 6. Geranyl Acetate | 12. α-Amorphene | 18. Farnesyl Acetate |



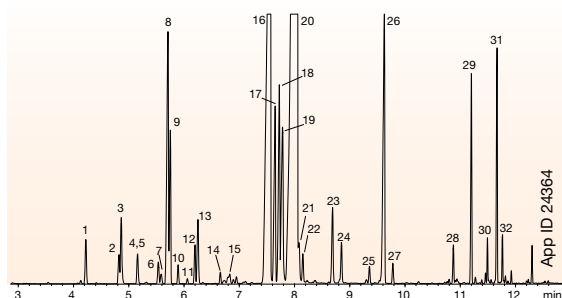
Peppermint Oil



Column: Zebron ZB-1PLUS
Dimensions: 10 meter x 0.10 mm x 0.10 μm
Part No.: 7CB-G031-02
Injection: Split 120:1 @ 160 °C, 0.2 μL
Carrier Gas: Helium @ 0.3 mL/min (constant flow)
Oven Program: 45 °C for 2 min to 130 °C @ 10 °C/min to 280 °C @ 30 °C/min for 3 min
Detector: MSD
Recommended Liner: Zebron PLUS Single Taper Z-Liner™
Liner Part No.: AG2-0A13-05 (for Agilent® System)

Sample: Analytes are 10% in dichloromethane

- | | | |
|-------------------|--------------------------|------------------------|
| 1. α-Pinene | 12. γ-Terpinene | 22. α-Terpeneol |
| 2. Sabinene | 13. cis-Sabinene Hydrate | 23. Pulegone |
| 3. β-Pinene | 14. β-Terpeneol | 24. Piperitone |
| 4. β-Myrcene | 15. Linalool | 25. Neomenthyl Acetate |
| 5. 3-Octanol | 16. Menthone | 26. Menthyl Acetate |
| 6. α-Terpinene | 17. Isomenthone | 27. Isomenthyl Acetate |
| 7. Cymene | 18. Menthonefuran | 28. Bourbonene |
| 8. Eucalyptol | 19. Neomenthol | 29. Caryophyllene |
| 9. δ-Limonene | 20. Menthol | 30. Farnesene |
| 10. cis-Ocimene | 21. Neoisomenthol | 31. Germacrene |
| 11. trans-Ocimene | | 32. Elemene |



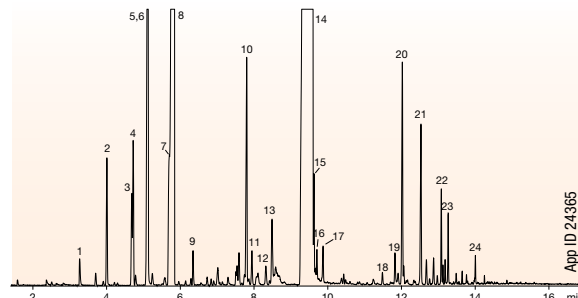
Spearmint Oil



Column: Zebron ZB-1PLUS
Dimensions: 10 meter x 0.10 mm x 0.10 μm
Part No.: 7CB-G031-02
Injection: Split 120:1 @ 160 °C, 0.2 μL
Carrier Gas: Helium @ 0.4 mL/min (constant flow)
Oven Program: 45 °C for 2 min to 130 °C @ 8 °C/min to 200 °C @ 30 °C/min for 2 min
Detector: MSD; 18-400 amu
Recommended Liner: Zebron PLUS Single Taper Z-Liner™
Liner Part No.: AG2-0A13-05 (for Agilent® System)

Sample: Analytes are 10% in dichloromethane

- | | |
|-------------------------------|-------------------------|
| 1. 2,5-Diethyltetrahydrofuran | 13. Dihydrocarveol |
| 2. α-Pinene | 14. Carvone |
| 3. Sabinene | 15. Piperitenone |
| 4. β-Pinene | 16. trans-Carvone Oxide |
| 5. β-Myrcene | 17. cis-Carvone Oxide |
| 6. 3-Octanol | 18. Carvyl Acetate |
| 7. Eucalyptol | 19. cis-Jasmone |
| 8. Limonene | 20. β-Bourbonene |
| 9. cis-Sabinene Hydrate | 21. Caryophyllene |
| 10. Menthone | 22. β-Farnesene |
| 11. Isomenthone | 23. Germacrene D |
| 12. 4-Terpeneol | 24. Caryophyllene Oxide |



Sterols

by GC-FID

Sterols are naturally occurring steroid alcohols in plants, animals, and fungi. Phytosterols and cholesterol are commonly tested; sterol content for example is analyzed to determine olive oil quality and authenticity. Dietary tocopherols are sometimes tested with sterols due to their related health effects. Methods for analysis of sterols from common food matrices and in combination with tocopherols are demonstrated below.

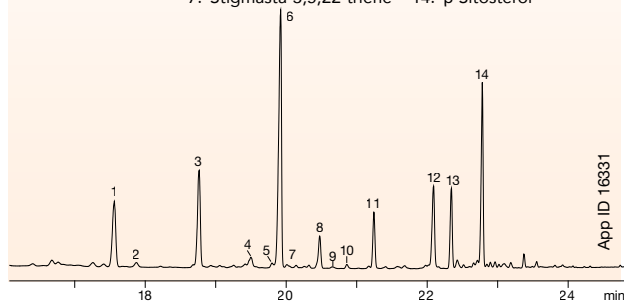
Vitamin E and Sterols



Column: Zebron™ ZB-5
Dimensions: 30 meter x 0.25 mm x 0.10 µm
Part No.: 7HG-G002-02
Injection: Splitless @ 220 °C, 1 µL
Carrier Gas: Helium @ 1.8 mL/min (constant flow)
Oven Program: 110 °C for 0.2 min to 140 °C @ 30 °C/min to 230 °C @ 10 °C/min for 6 min to 340 °C @ 10 °C/min for 15.8 min
Detector: FID @ 340 °C
Recommended Liner: Zebron PLUS Single Taper Z-Liner™
Liner Part No.: AG2-0A13-05 (for Agilent® System)

Sample: Analytes derivatized via BSTFA:TMCS; 99:1 in pyridine

- | | |
|----------------------------|------------------------|
| 1. Squalene | 8. γ-Tocomoenoel |
| 2. Lignoceric acid | 9. Stigmasta-3,5-diene |
| 3. δ-Tocopherol | 10. Cholesterol |
| 4. δ-Tocomoenoel | 11. α-Tocopherol |
| 5. Campesta-3,5-diene | 12. Campesterol |
| 6. γ-Tocopherol | 13. Stigmasterol |
| 7. Stigmasta-3,5,22-triene | 14. β-Sitosterol |



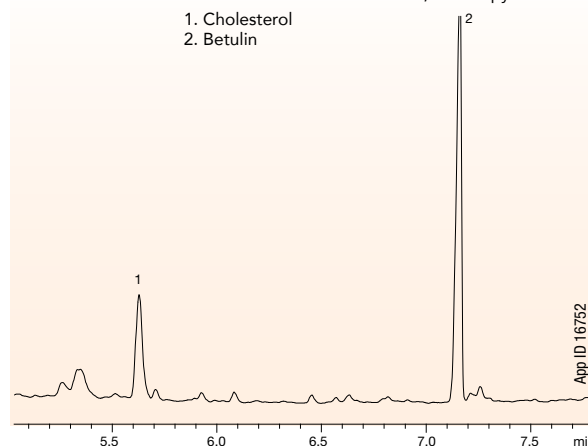
Lard Sterols



Column: Zebron ZB-5HT Inferno™
Dimensions: 30 meter x 0.25 mm x 0.10 µm
Part No.: 7HG-G015-02
Injection: Splitless @ 350 °C, 0.5 µL
Carrier Gas: Helium @ 2 mL/min (constant flow)
Oven Program: 220 °C to 350 °C @ 15 °C/min
Detector: FID @ 350 °C
Recommended Liner: Zebron PLUS Single Taper Z-Liner™
Liner Part No.: AG2-0A13-05 (for Agilent® System)

Sample: Prepared by saponification, solid phase extraction (SPE), and derivatization via BSTFA:TMCS; 99:1 in pyridine

1. Cholesterol
2. Betulin



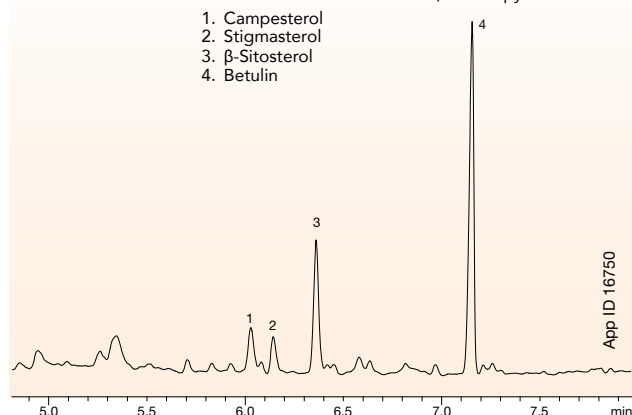
Margarine Sterols



Column: Zebron ZB-5HT Inferno
Dimensions: 30 meter x 0.25 mm x 0.10 µm
Part No.: 7HG-G015-02
Injection: Splitless @ 350 °C, 0.5 µL
Carrier Gas: Helium @ 2 mL/min (constant flow)
Oven Program: 220 °C to 350 °C @ 15 °C/min
Detector: FID @ 350 °C
Recommended Liner: Zebron PLUS Single Taper Z-Liner™
Liner Part No.: AG2-0A13-05 (for Agilent® System)

Sample: Prepared by saponification, solid phase extraction (SPE), and derivatization via BSTFA: TMCS; 99:1 in pyridine

1. Campesterol
2. Stigmasterol
3. β-Sitosterol
4. Betulin



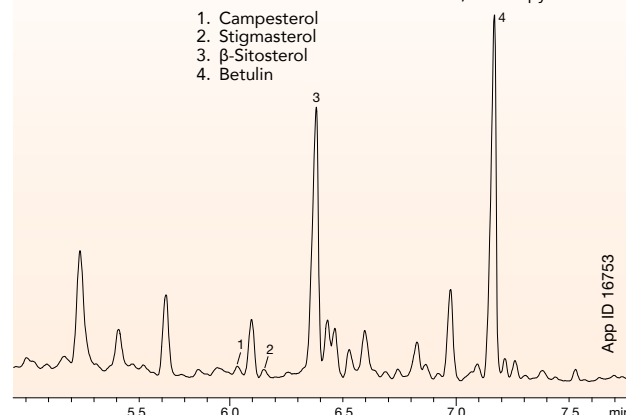
Olive Oil Sterols



Column: Zebron ZB-5HT Inferno
Dimensions: 30 meter x 0.25 mm x 0.10 µm
Part No.: 7HG-G015-02
Injection: Splitless @ 350 °C, 0.5 µL
Carrier Gas: Helium @ 2 mL/min (constant flow)
Oven Program: 220 °C to 350 °C @ 15 °C/min
Detector: FID @ 350 °C
Recommended Liner: Zebron PLUS Single Taper Z-Liner™
Liner Part No.: AG2-0A13-05 (for Agilent® System)

Sample: Prepared by saponification, solid phase extraction (SPE), and derivatization via BSTFA:TMCS; 99:1 in pyridine

1. Campesterol
2. Stigmasterol
3. β-Sitosterol
4. Betulin



Triglycerides

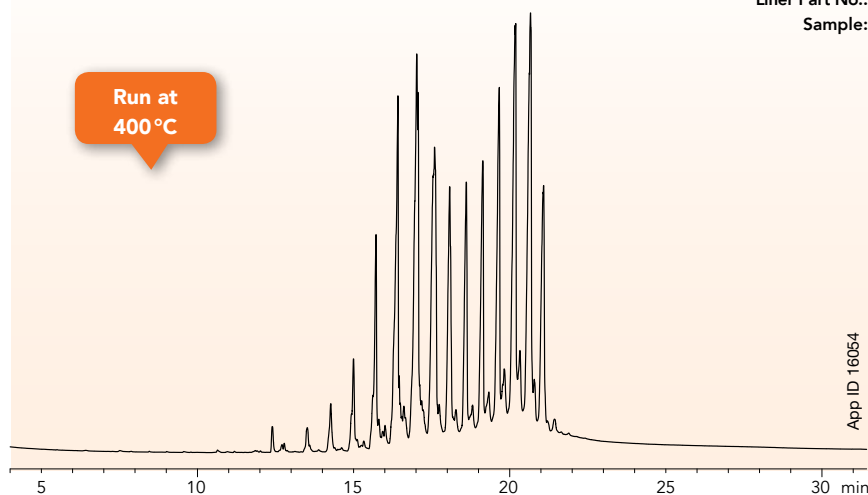
by GC-FID

Triglycerides are naturally occurring esters of fatty acids and glycerol. Because these compounds have relatively high molecular weights and polarities that increase with the degree of unsaturation, high oven temperatures are necessary for sufficient separations. Choosing a GC column designed to withstand such temperatures (such as those with improved polyimide coatings that resist brittleness at 400 °C or higher) can provide the necessary robustness to achieve good separation. The separations below are performed using a Zebtron™ ZB-5HT Inferno™ GC column, which is specifically designed to withstand high oven temperatures.

Butter Triglycerides



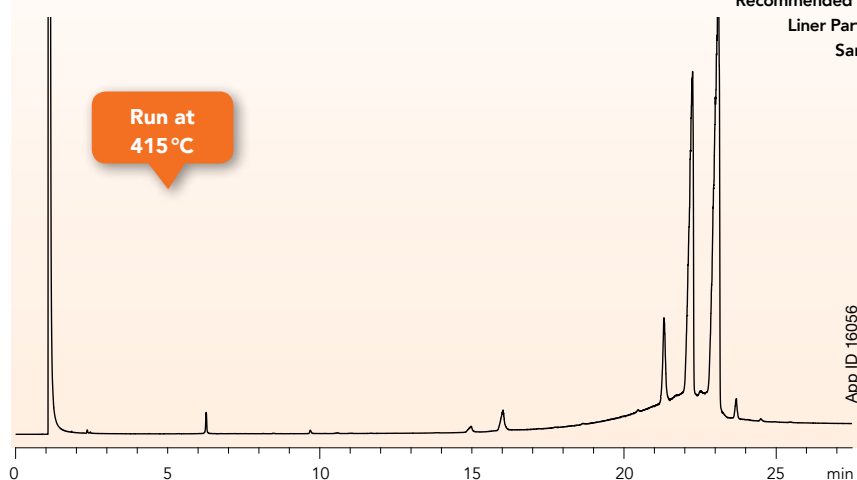
Column: Zebtron ZB-5HT Inferno
Dimensions: 15 meter x 0.32 mm x 0.10 µm
Part No.: 7EM-G015-02
Injection: On-Column @ 103 °C, 2 µL
Carrier Gas: Helium @ 1.8 mL/min (constant flow)
Oven Program: 100 °C to 400 °C @ 14 °C/min for 10 min
Detector: FID @ 400 °C
Recommended Liner: Zebtron PLUS Direct Connect Liner
Liner Part No.: AG2-0A50-05 (for Agilent® System)
Sample: Butter Triglycerides



Olive Oil Triglycerides



Column: Zebtron ZB-5HT Inferno
Dimensions: 30 meter x 0.25 mm x 0.10 µm
Part No.: 7HG-G015-02
Injection: On-Column @ 223 °C, 0.1 µL
Carrier Gas: Helium @ 1 mL/min (constant flow)
Oven Program: 220 °C for 1 min to 400 °C @ 8 °C/min for 4 min
Detector: FID @ 415 °C
Recommended Liner: Zebtron PLUS Direct Connect Liner
Liner Part No.: AG2-0A50-05 (for Agilent® System)
Sample: Olive Oil Triglycerides

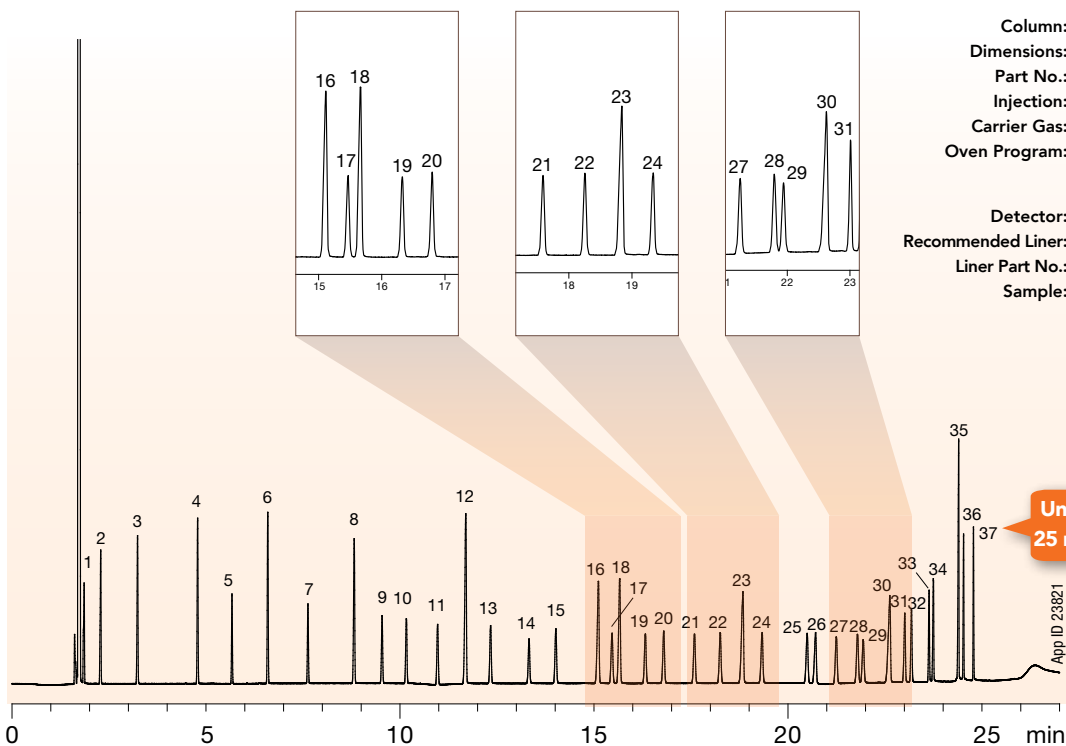


Fatty Acids and FAMES

by GC-FID

Fat and oil testing is important for both characterization as well as determination of total fat content. Both fatty acid methyl esters (FAMES) and free fatty acids (FFAs) are commonly analyzed using polar column phases. The examples below display good resolution for both derivatized and underivatized fatty acids.

Food Industry FAMES



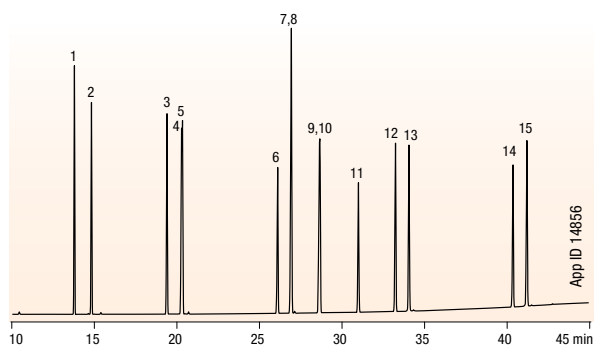
Column: Zebron™ ZB-FAME
 Dimensions: 30 meter x 0.25 mm x 0.20 μm
 Part No.: 7HG-G033-10
 Injection: Split 50:1 @ 240°C, 1 μL
 Carrier Gas: Helium @ 1.2 mL/min (constant flow)
 Oven Program: 100°C for 2 min to 140°C @ 10°C/min to 190°C @ 3°C/min to 260°C @ 30°C/min for 2 min
 Detector: FID @ 260°C
 Recommended Liner: Zebron Single Taper Z-Liner™
 Liner Part No.: AG2-0A13-05 (for Agilent® System)
 Sample: See list at www.phenomenex.com/FAME

SEE MORE FAME Separations pp. 10 - 18

Unsaturated FAMES

Column: Zebron ZB-FFAP
 Dimensions: 60 meter x 0.25 mm x 0.25 μm
 Part No.: 7KG-G009-11
 Injection: Split 40:1 @ 220°C, 0.1 μL
 Carrier Gas: Helium @ 2.4 mL/min (constant flow)
 Oven Program: 200°C to 260°C @ 2°C/min for 30 min
 Detector: FID @ 250°C
 Recommended Liner: Zebron PLUS Single Taper Z-Liner™
 Liner Part No.: AG2-0A13-05 (Agilent® for systems)

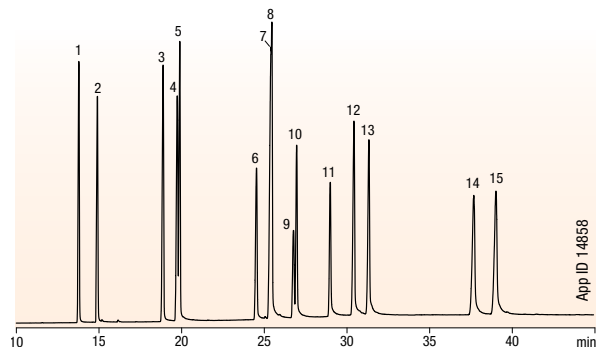
- | | |
|--------------------------|------------------------|
| 1. Methyl Myristate | 10. Methyl Linelaidate |
| 2. Methyl Myristoleate | 11. Methyl Linolenate |
| 3. Methyl Palmitate | 12. Methyl Arachidate |
| 4. Methyl Palmitelaidate | 13. Methyl Gondonate |
| 5. Methyl Palmitoleate | 14. Methyl Behenate |
| 6. Methyl Stearate | 15. Methyl Erucate |
| 7. Methyl Oleate | |
| 8. Methyl Elaidate | |
| 9. Methyl Linoleate | |



Unsaturated Free Fatty Acids

Column: Zebron ZB-FFAP
 Dimensions: 60 meter x 0.25 mm x 0.25 μm
 Part No.: 7KG-G009-11
 Injection: Split 40:1 @ 220°C, 0.2 μL
 Carrier Gas: Helium @ 2.4 mL/min (constant flow)
 Oven Program: 200°C to 260°C @ 2°C/min for 30 min
 Detector: FID @ 250°C
 Recommended Liner: Zebron PLUS Single Taper Z-Liner™
 Liner Part No.: AG2-0A13-05 (Agilent® for systems)

- | | |
|-----------------------|-------------------------|
| 1. Myristic Acid | 10. Linoleic Acid |
| 2. Myristoleic Acid | 11. Linolenic Acid |
| 3. Palmitic Acid | 12. Arachidic Acid |
| 4. Palmitelaidic Acid | 13. Gondonic Acid (C15) |
| 5. Palmitoleic Acid | 14. Behenic Acid (C17) |
| 6. Stearic Acid | 15. Erucic Acid (C19) |
| 7. Elaidic Acid | |
| 8. Oleic Acid | |
| 9. Linolelaidic Acid | |



Fatty Acids and FAMES

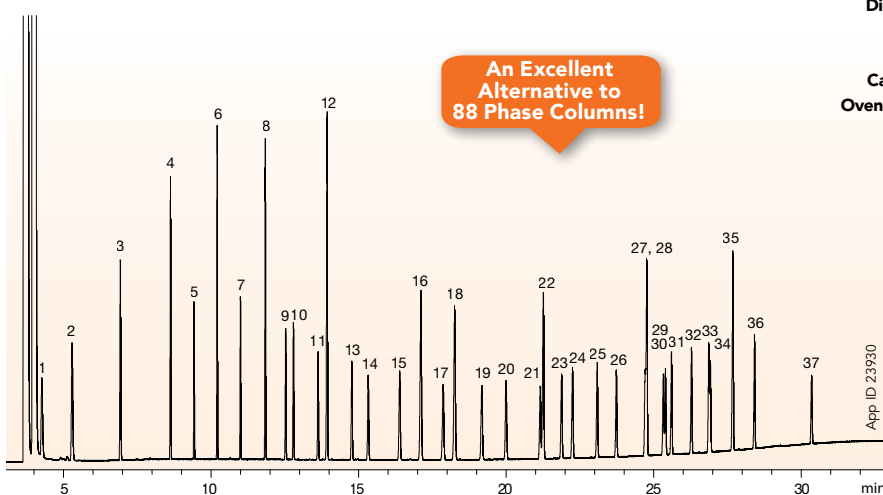
by GC-FID

Olive Oil and Hydrogenated Oil

- Recommended alternative to Supelco® SP™-2560, Agilent® CP-Sil 88, Agilent HP-88, and Restek® Rt®-2560
- Traditional separation of cis/trans FAMES



37 FAME Mix



An Excellent Alternative to 88 Phase Columns!

Column: Zebron™ ZB-88
Dimensions: 100 meter x 0.25 mm x 0.20 µm
Part No.: 7MG-G037-10
Injection: Split 50:1 @ 250°C, 1 µL
Carrier Gas: Hydrogen @ 2 mL/min (constant flow)
Oven Program: 120°C for 1 min to 175°C @ 10°C/min for 10 min to 210°C @ 5°C/min for 5 min to 230°C @ 5°C/min for 5 min
Detector: FID @ 280°C

Sample:

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

Omega-3 Fatty Acids and Fish Oil

- Recommended alternative to Supelco® SP™-2330, Agilent® DB®-23, and Restek® Rtx®-2330
- Alternate selectivity well suited for marine oils

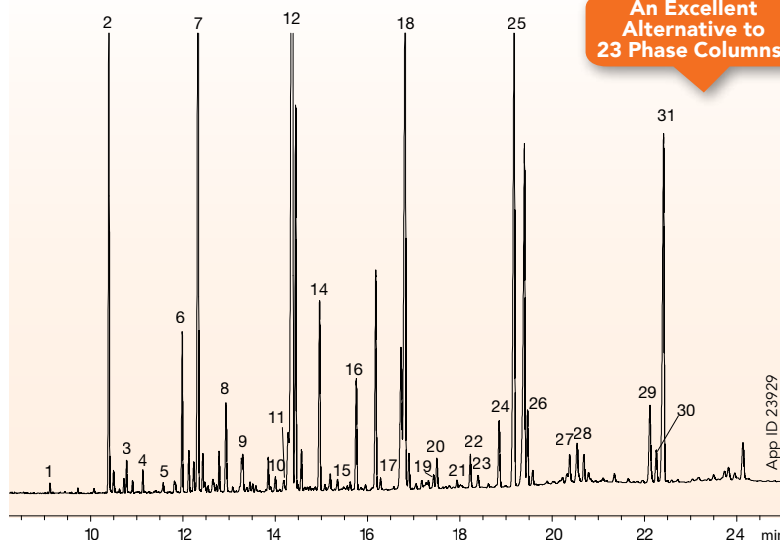


Column: Zebron ZB-23
Dimensions: 60 meter x 0.25 mm x 0.15 µm
Part No.: 7KG-G039-05
Injection: Split 50:1 @ 250°C, 1 µL
Carrier Gas: Helium @ 33 cm/s @ 50°C (constant flow)
Oven Program: 50°C for 1 min to 175°C @ 25°C/min to 230°C @ 4°C/min for 5 min
Detector: FID @ 280°C

Sample:

1. C12:0	21. C20:3 cis 8,11,14
2. C14:0	22. C20:4 cis 5,8,11,14
3. C14:1 cis 9	23. C20:3 cis 11,14,17
4. C15:0	24. C22:0
5. C15:1 cis 10	25. C20:5 cis 5,8,11,14,17
6. C16:0	26. C22:1 cis 13
7. C16:1 cis 9	27. C23:0
8. C17:0	28. C22:2 cis 13,16
9. C17:1 cis 10	29. C24:0
10. C18:0	30. C24:1 cis 15
11. C18:1 trans 9	31. C22:6 cis 4,7,10,13,16,19
12. C18:1 cis 9	
13. C18:2 trans 9,12	
14. C18:2 cis 9,12	
15. C18:3 cis 6,9,12	
16. C18:3 cis 9,12,15	
17. C20:0	
18. C20:1 cis 11	
19. C21:0	
20. C20:2 cis 11,14	

Unsaturated Fatty Acids from Marine Oil



An Excellent Alternative to 23 Phase Columns!

Fatty Acids and FAMES

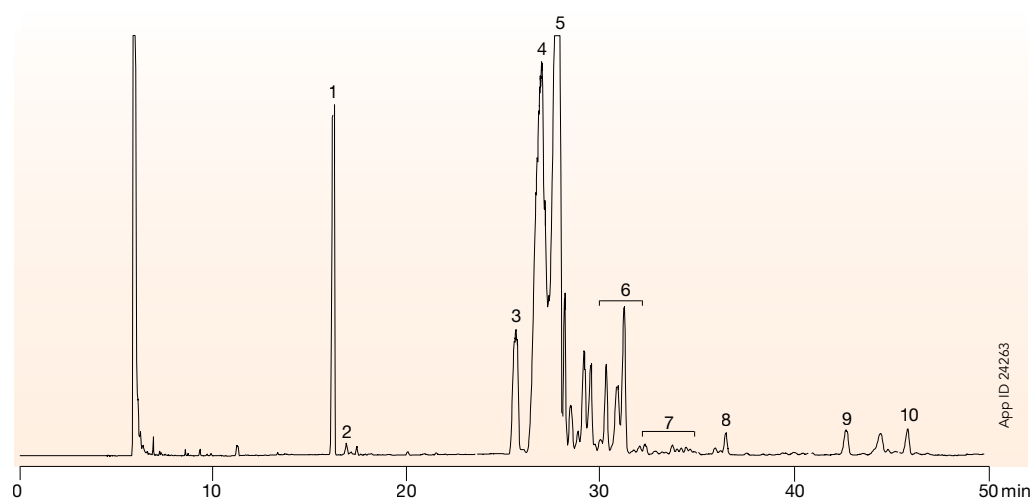
by GC-FID

FAMES in Canola Oil Margarine



Column: Zebron™ ZB-23
Dimensions: 60 meter x 0.25 mm x 0.25 μm
Part No.: 7KG-G039-11
Injection: Split 100:1 @ 210 °C, 1μL
Carrier Gas: Helium @ 0.44 mL/min (constant flow)
Oven Program: 150 °C to 200 °C @ 1.3 °C/min for 10 min
Detector: FID @ 210 °C

- Sample:**
1. C16:0
 2. C16:1
 3. C18:0
 4. C18:1 trans
 5. C18:1 cis
 6. C18:2 trans
 7. C18:2 cis
 8. C18:3
 9. C20:0
 10. C20:1

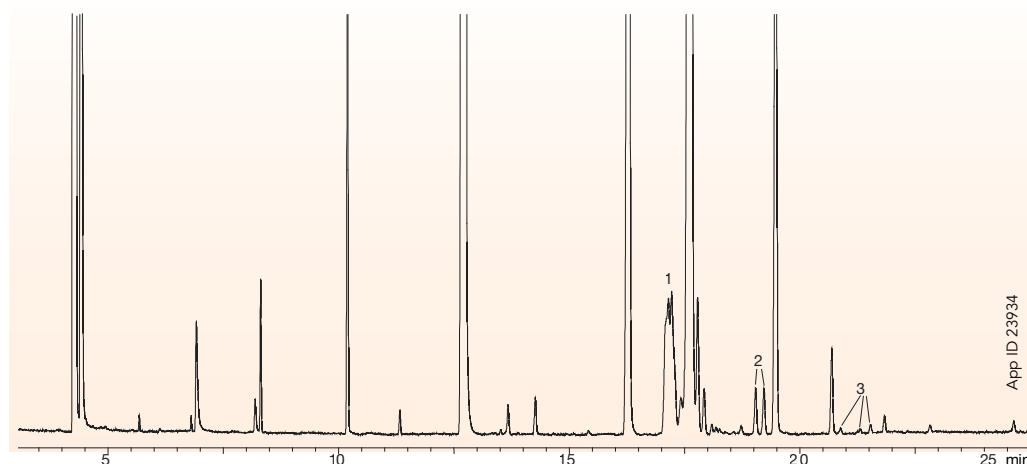


FAMES in Rapeseed Oil



Column: Zebron ZB-88
Dimensions: 100 meter x 0.25 mm x 0.20 μm
Part No.: 7MG-G037-10
Injection: Split 50:1 @ 250 °C, 1μL
Carrier Gas: Hydrogen @ 2 mL/min (constant flow)
Oven Program: 20 °C for 1 min to 175 °C @ 10 °C/min hold 10 min to 210 °C @ 5 °C/min hold 5 min
Detector: FID @ 280 °C

- Sample:**
1. C18:1 trans
 2. C18:2 trans
 3. C18:3 trans



Fatty Acids and FAMES

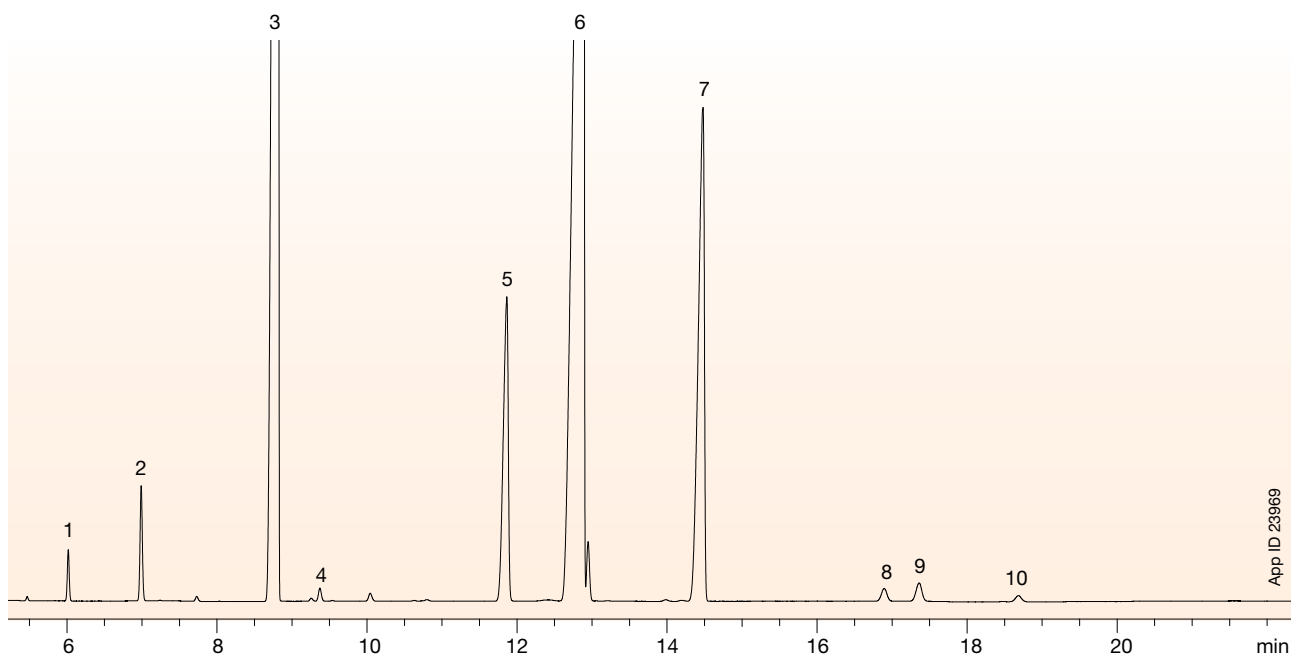
by GC-FID



ZB-FAME

Palm Oil

Palm oil's balanced ratio of saturated and unsaturated fatty acids makes it suitable for use in a variety of food products including frying oil and margarine, making it one of the most widely traded fats and oils. As a heavily imported and exported product, analytical testing of palm oil is important to ensure its quality and safety.



App ID 23969

Extraction and Derivatization Protocol:

1. Strata® Si-1 Tube, 2 g/12 mL (Part No.: 8B-S012-KDG) on a vacuum manifold or Presston™ 100 positive pressure manifold
2. Wash cartridge with 6 mL of hexane
3. Load oil solution (0.2 g of oil in 3.8 mL of hexane)
4. Elute with 5 mL hexane/ethyl acetate (87:13)
5. Evaporate eluate under a steady stream of nitrogen
6. Reconstitute with 0.4 mL of hexane
7. Add 200 µL of 2 M potassium hydroxide in methanol to purified oil solution
8. Cap tube and vortex
9. Wait 5 minutes
10. Add 2 mL of Milli-Q® water, vortex
11. Allow solution to settle then transfer top layer to Q-sert vial for GC analysis

Column: Zebron™ ZB-FAME

Dimensions: 60 meter x 0.25 mm x 0.20 µm

Part No.: 7KG-G033-10

Injection: Split 100:1 @ 240°C, 1 µL

Carrier Gas: Helium @ 1.2 mL/min (constant flow)

Oven Program: 180°C isothermal

Detector: FID @ 240°C

Recommended Liner: Zebron PLUS Single Taper with Wool

Liner Part No.: AG2-0A11-05 (for Agilent® systems)

Sample:

1. C12:0
2. C14:0
3. C16:0
4. C16:1 cis 9
5. C18:0
6. C18:1 cis 9
7. C18:2 cis 9,12
8. C18:3 cis 9,12,15
9. C20:0
10. C20:1 cis 11

Fatty Acids and FAMES

by GC-FID



ZB-FAME

Olive Oil

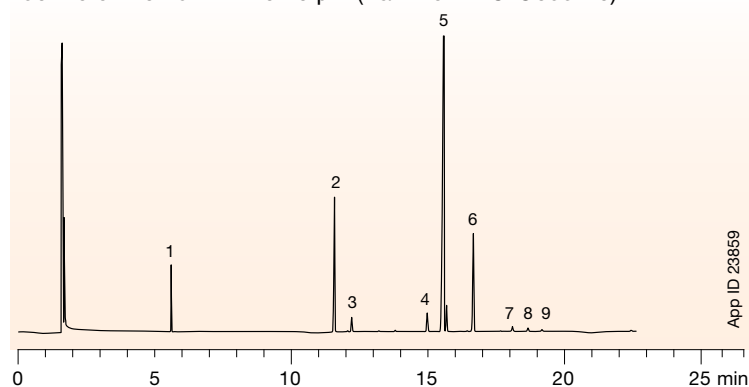
One of the most popular applications around the world has been optimized using Zebtron™ ZB-FAME! The high-cyano phase chemistry meets requirements for IOC olive oil testing methods, while providing an opportunity for improved productivity. Achieve great results on ZB-FAME using the standard 60 meter dimension – or save time and money by switching to a 30 meter column!

Regular Olive Oil

30 meter column shortens traditional run times!

A. Zebron ZB-FAME

30 meter x 0.25 mm x 0.20 μm (Part No. 7HG-G033-10)

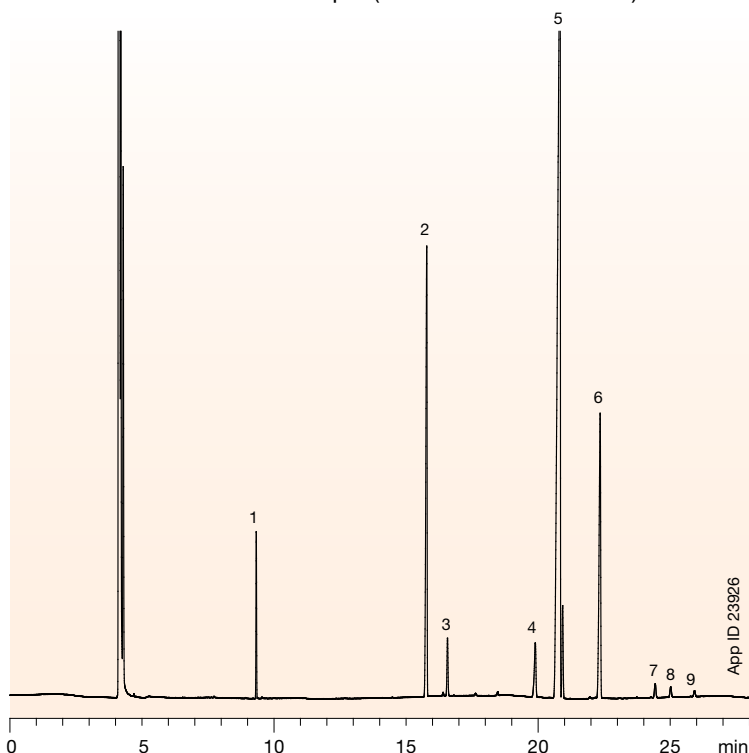


Extraction and Derivatization Protocol:

1. Strata® Si-1 Tube, 1 g/6 mL (Part No.: 8B-S012-JCH) on a vacuum manifold or Presston™ 100 positive pressure manifold
2. Wash cartridge with 6 mL of hexane
3. Load oil solution (0.12 g of oil in 0.5 mL of hexane)
4. Elute with 10 mL of hexane/diethyl ether (87:13)
5. Evaporate eluate under a steady stream of nitrogen
6. Dissolve purified oil residue in 1 mL of heptane
7. Add 0.1 mL of 2 N potassium hydroxide in methanol to purified oil solution
8. Cap tube and shake vigorously for 15 seconds
9. Leave to separate until upper layer becomes clear
10. Extract upper layer for GC analysis

B. Zebron ZB-FAME

60 meter x 0.25 mm x 0.20 μm (Part No.: 7KG-G033-10)



Conditions for all separations, except where noted:

- Column: Zebron ZB-FAME
- Dimensions: As listed
- Injection: Split 50:1 @ 240°C, 1 μL
- Carrier Gas: Helium @ 1.2 mL/min (constant flow)
- Oven Program: A) 100°C for 2 min to 140°C @ 10°C/min to 190°C @ 3°C/min to 260°C @ 30°C/min for 2 min
B) 100°C for 2 min to 165°C @ 10°C/min to 200°C @ 1.5°C/min to 280°C @ 15°C/min for 1 min
- Detector: FID @ 260°C
- Recommended Liner: Zebtron PLUS Single Taper with Wool
- Liner Part No.: AG2-0A11-05 (for Agilent® systems)
- Sample: Analytes are diluted 5:1 in heptane
 1. C11:0*
 2. C16:0
 3. C16:1 cis 9
 4. C18:0
 5. C18:1 cis 9
 6. C18:2 cis 9,12
 7. C18:3 cis 9,12,15
 8. C20:0
 9. C20:1 cis 11

*internal standard

Fatty Acids and FAMES

by GC-FID

ZB-FAME

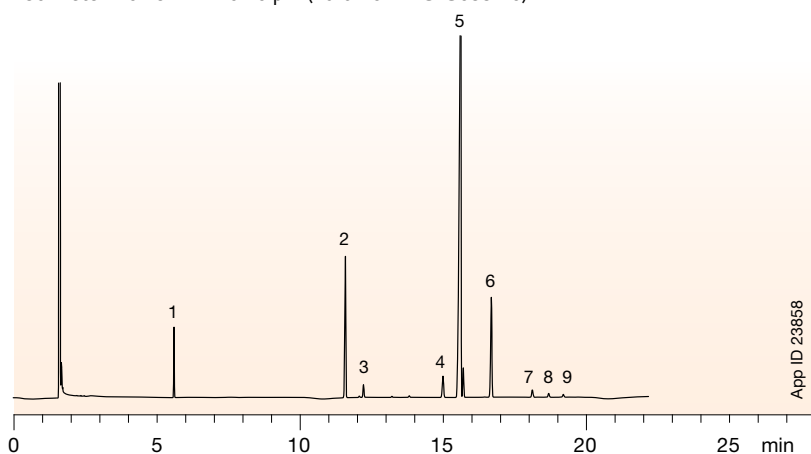
Extra Virgin Olive Oil



Reduce run times with a 30 meter column!

A. Zebtron™ ZB-FAME

30 meter x 0.25 mm x 0.20 μm (Part No. 7HG-G033-10)



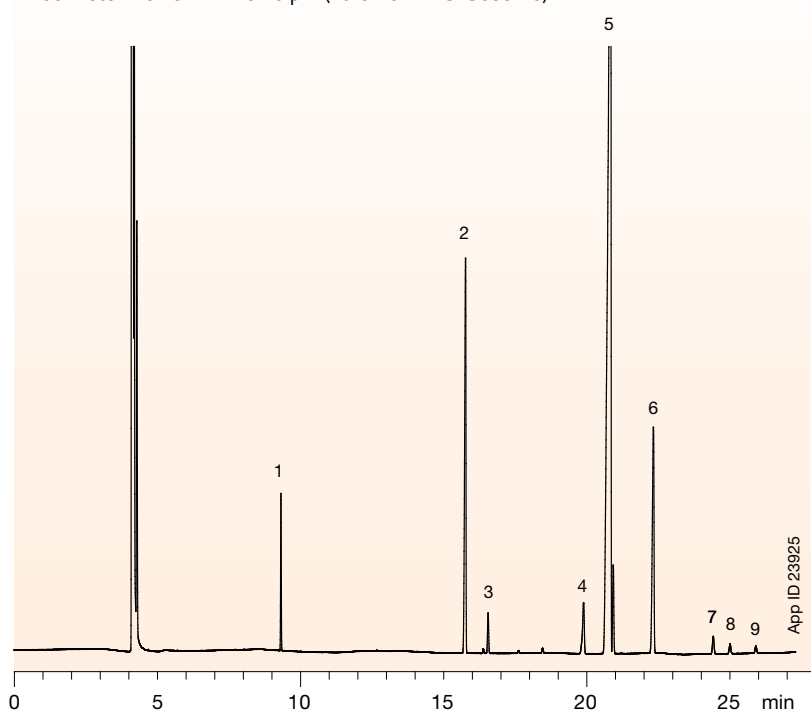
App ID 23858

Extraction and Derivatization Protocol:

1. Strata® Si-1 Tube, 1 g/6 mL (Part No.: 8B-S012-JCH) on a vacuum manifold or Presston™ 100 positive pressure manifold
2. Wash cartridge with 6 mL of hexane
3. Load oil solution (0.12 g of oil in 0.5 mL of hexane)
4. Elute with 10 mL of hexane/diethyl ether (87:13)
5. Evaporate eluate under a steady stream of nitrogen
6. Dissolve purified oil residue in 1 mL of heptane
7. Add 0.1 mL of 2 N potassium hydroxide in methanol to purified oil solution
8. Cap tube and shake vigorously for 15 seconds
9. Leave to separate until upper layer becomes clear
10. Extract upper layer for GC analysis

B. Zebtron ZB-FAME

60 meter x 0.25 mm x 0.20 μm (Part No.: 7KG-G033-10)



App ID 23925

Conditions for all separations, except where noted:

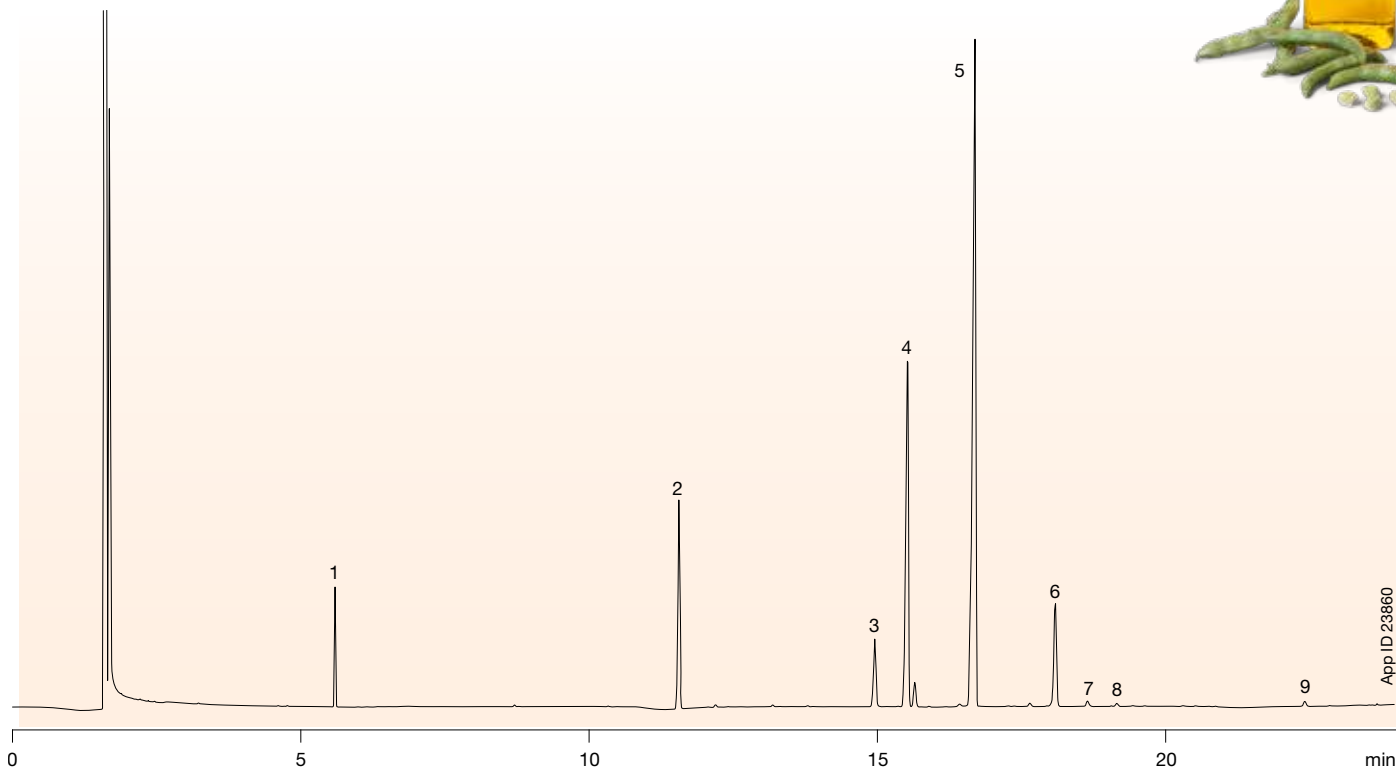
- Column: Zebtron ZB-FAME
 - Dimensions: As listed
 - Injection: Split 50:1 @ 240 °C, 1 μL
 - Carrier Gas: Helium @ 1.2 mL/min (constant flow)
 - Oven Program: A) 100 °C for 2 min to 140 °C @ 10 °C/min to 190 °C @ 3 °C/min to 260 °C @ 30 °C/min for 2 min
B) 100 °C for 2 min to 165 °C @ 10 °C/min to 200 °C @ 1.5 °C/min to 280 °C @ 15 °C/min for 1 min
 - Detector: FID @ 260 °C
 - Recommended Liner: Zebtron PLUS Single Taper with Wool
 - Liner Part No.: AG2-0A11-05 (for Agilent® systems)
 - Sample: Analytes are diluted 5:1 in heptane
 1. C11:0*
 2. C16:0
 3. C16:1 cis 9
 4. C18:0
 5. C18:1 cis 9
 6. C18:2 cis 9,12
 7. C18:3 cis 9,12,15
 8. C20:0
 9. C20:1 cis 11
- *internal standard

Fatty Acids and FAMES

by GC-FID

Soybean Oil

Soybean oil is used in a multitude of foods, such as salad dressings, baked goods and fried foods. The below method using a short Zebron™ ZB-FAME column effectively separates difficult C18 cis/trans isomers quickly and accurately.



Extraction and Derivatization Protocol:

1. Strata® Si-1 Tube, 1 g/6 mL (Part No.: 8B-S012-JCH) on a vacuum manifold or Presston™ positive pressure manifold
2. Wash cartridge with 6 mL of hexane
3. Load oil solution (0.12 g of oil in 0.5 mL of hexane)
4. Elute with 10 mL of hexane/diethyl ether (87:13)
5. Evaporate eluate under a steady stream of nitrogen
6. Dissolve purified oil residue in 1 mL of heptane
7. Add 0.1 mL of 2 N potassium hydroxide in methanol to purified oil solution
8. Cap tube and shake vigorously for 15 seconds
9. Leave to separate until upper layer becomes clear
10. Extract upper layer for GC analysis

Column: Zebron ZB-FAME

Dimensions: 30 meter x 0.25 mm x 0.20 µm

Part No.: 7HG-G033-10

Injection: Split 50:1 @ 240°C, 1 µL

Carrier Gas: Helium @ 1.2 mL/min (constant flow)

Oven Program: 100°C for 2 min to 140°C @ 10°C/min to 190°C @ 3°C/min to 260°C @ 30°C/min for 2 min

Detector: FID @ 260°C

Recommended Liner: Zebron PLUS Single Taper with Wool

Liner Part No.: AG2-0A11-05 (for Agilent® systems)

Sample: Analytes are diluted 5:1 in heptane

1. C11:0
2. C16:0
3. C18:0
4. C18:1 cis 9
5. C18:2 cis 9,12
6. C18:3 cis 9,12,15
7. C20:0
8. C20:1 cis 11
9. C22:0

Fatty Acids and FAMES

by GC-FID

ZB-FAME

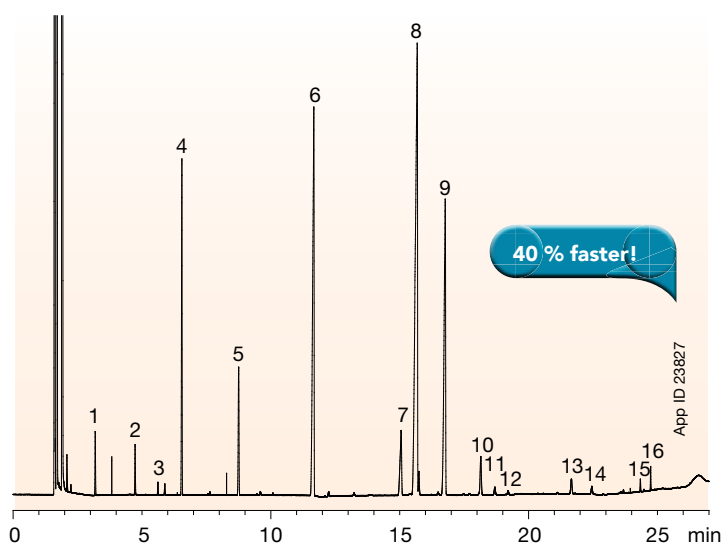


Powdered Infant Formula

Infant formula, like human milk, contains a variety of fatty acids. Using Zebron™ ZB-FAME, 16 fatty acids were successfully separated in a 40% faster run compared to a traditional column used for the analysis.

Zebron ZB-FAME

A. 30 meter x 0.25 mm x 0.20 µm (Part No.: 7HG-G033-10)



Extraction and Derivatization Protocol:

1. Weigh out approximately 500 mg of powdered infant formula into a scintillation vial
2. Dissolve (or dilute) sample in 5 mL toluene, then add 6 mL 10 % acetyl chloride solution in methanol
3. Incubate @ 80 °C for 2 hours
4. After incubation add 10 mL 10 % Na₂CO₃ solution and centrifuge at 5000 rpm for 5 min
5. Extract organic layer for GC analysis

Conditions for both columns:

Dimensions: As listed

Injection: Split 50:1 @ 240 °C, 1 µL

Carrier Gas: A) Helium @ 1.2 mL/min (constant flow)
B) Helium @ 20 cm/sec (constant flow)

Oven Program: A) 100 °C for 2 min to 140 °C @ 10 °C/min to 190 °C @ 3 °C/min to 260 °C @ 30 °C/min for 2 min
B) 140 °C for 5 min to 240 °C @ 4 °C/min for 15 min

Detector: FID @ 260 °C

Recommended Liner: Zebron PLUS Single Taper with Wool

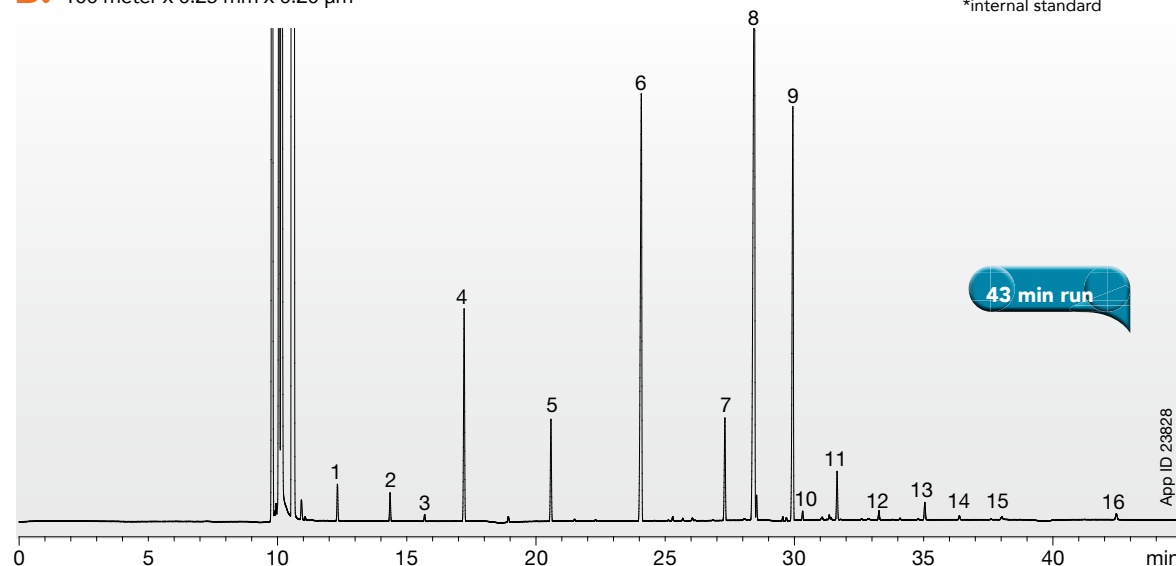
Liner Part No.: AG2-0A11-05 (for Agilent® systems)

- Sample:**
1. C8:0
 2. C10:0
 3. C11:0*
 4. C12:0
 5. C14:0
 6. C16:0
 7. C18:0
 8. C18:1 cis 9
 9. C18:2 cis 9,12
 10. C18:3 cis 9,12,15
 11. C20:0
 12. C20:1 cis 11
 13. C20:4 cis 5,8,11,14
 14. C22:0
 15. C24:0
 16. C22:6 cis 4,7,10,13,16,19
- *internal standard

Vs.

Supelco® SP™ -2560

B. 100 meter x 0.25 mm x 0.20 µm



Comparative separations may not be representative of all applications.

Fatty Acids and FAMES

by GC-FID

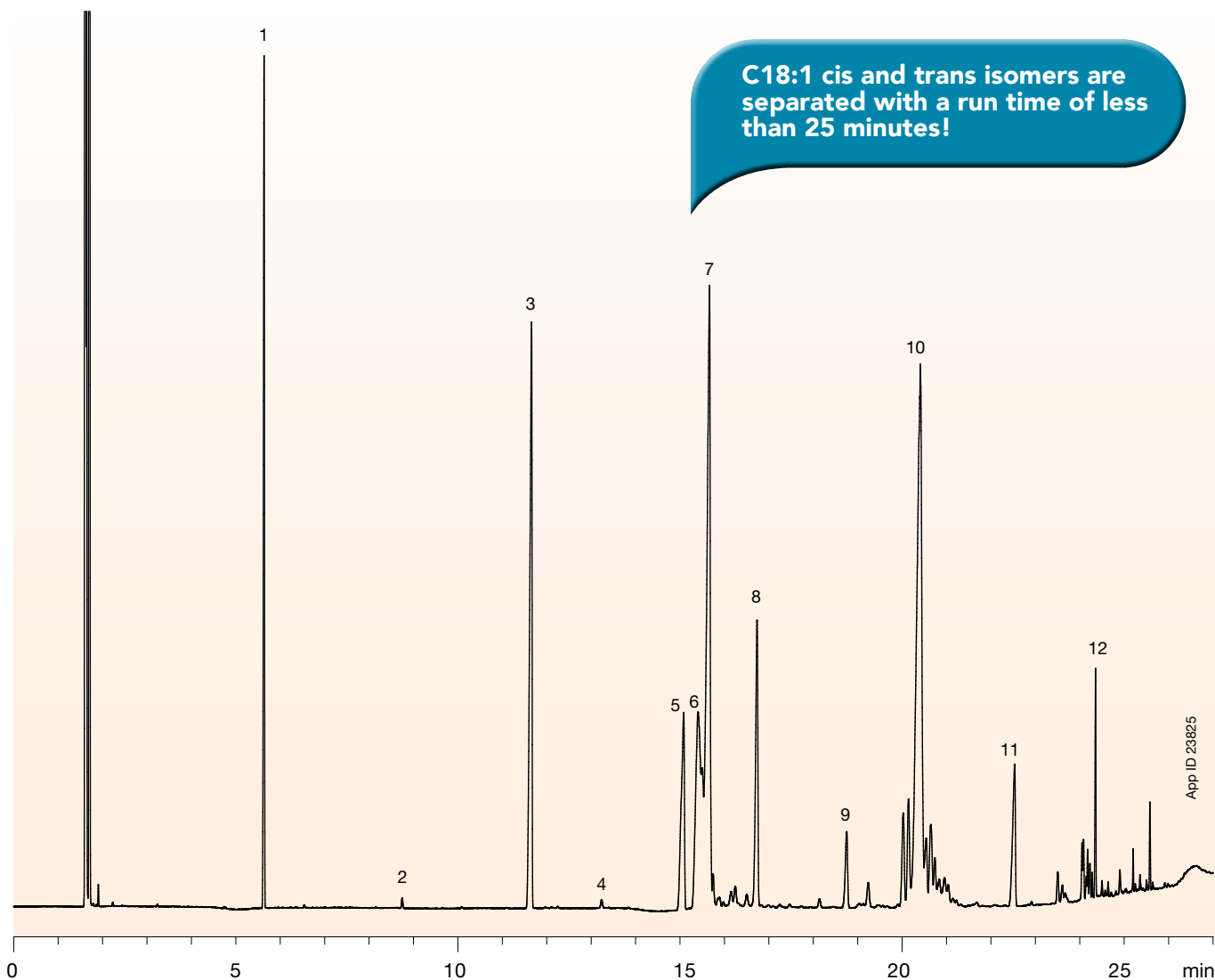


ZB-FAME

Peanut Butter

Comprised of a variety of fats, peanut butter can be analyzed using Zebron™ ZB-FAME in less than 25 minutes.

C18:1 cis and trans isomers are separated with a run time of less than 25 minutes!



App ID 23825

Extraction and Derivatization Protocol:

1. Weigh out 100 to 200 mg of peanut butter and place it into a scintillation vial
2. Add 100 mg pyrogalllic acid
3. Add 2 mL ethanol followed by 10 mL 8.3 M HCl
4. Incubate at 70°C for 45 min
5. Extract using 2 mL diethyl ether and 2 mL chloroform
6. Blow down extraction liquid
7. Reconstitute in 1 mL toluene and 2 mL 8 % boron trifluoride in methanol
8. Cap reaction mixture, hold @ 100°C for 45 min
9. After reaction, add 5 mL water, 1 mL hexane, and 1 g Na₂SO₄
10. Extract hexane layer for GC analysis

Column: Zebron ZB-FAME

Dimensions: 30 meter x 0.25mm x 0.20µm

Part No.: 7HG-G033-10

Injection: Split 50:1 @ 240°C, 1 µL

Carrier Gas: Helium @ 1.2 mL/min (constant flow)

Oven Program: 100°C for 2 min to 140°C @ 10°C/min to 190°C @ 3°C/min to 260°C @ 30°C/min for 2 min

Detector: FID @ 260°C

Recommended Liner: Zebron PLUS Single Taper with Wool

Liner Part No.: AG2-0A11-05 (for Agilent® systems)

- Sample:
1. C11:0*
 2. C14:0
 3. C16:0
 4. C17:0
 5. C18:0
 6. C18:1 trans 9
 7. C18:1 cis 9
 8. C18:2 cis 9,12
 9. C20:0
 10. C20:2 cis 11,14
 11. C22:0
 12. C24:0
- *internal standard

Fatty Acids and FAMES

by GC-FID



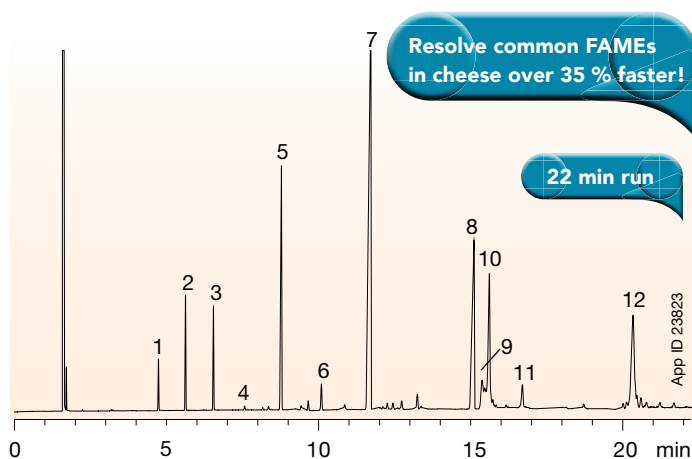
ZB-FAME

Monterey Jack Cheese

Cheese is comprised of a variety of fats, which are commonly analyzed for FAME content. Significantly reduce your run time using a Zebron™ ZB-FAME column as compared to traditional FAME methods.

Zebron ZB-FAME

A. 30 meter x 0.25 mm x 0.20 μm (Part No.: 7HG-G033-10)



Extraction and Derivatization Protocol:

1. Weigh out 100-200 mg of cheese and place it into a scintillation vial
2. Add 100 mg pyrogalllic acid
3. Add 2 mL ethanol followed by 4 mL deionized water and 4 mL NH₄OH (concentrated)
4. Incubate @ 70 °C for 20 min then add 10 mL HCl and incubate for an additional 25 min
5. Extract triglycerides using 2 mL diethyl ether and 2 mL chloroform
6. Blow down extraction liquid
7. Reconstitute in 1 mL toluene and 2 mL 8 % boron trifluoride in methanol
8. Cap reaction mixture, hold @ 100 °C for 45 min
9. After reaction, add 5 mL water, 1 mL hexane, and 1 g Na₂SO₄
10. Extract upper layer for GC analysis

Conditions for both columns:

Dimensions: As listed

Injection: Split 50:1 @ 240 °C, 1 μL

Carrier Gas: A) Helium @ 1.2 mL/min (constant flow)
B) Helium @ 20 cm/sec (constant flow)

Oven Program: A) 100 °C for 2 min to 140 °C @ 10 °C/min to 190 °C @ 3 °C/min to 260 °C @ 30 °C/min for 2 min
B) 140 °C for 5 min to 240 °C @ 4 °C/min for 15 min

Detector: FID @ 260 °C

Recommended Liner: Zebron PLUS Single Taper with Wool

Liner Part No.: AG2-0A11-05 (for Agilent® systems)

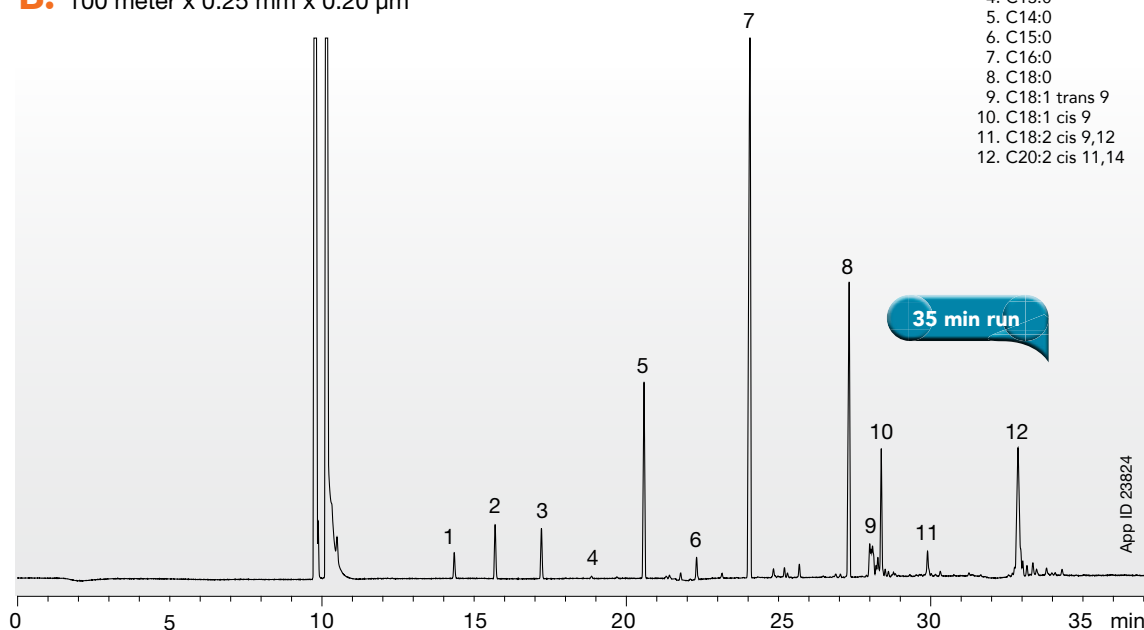
Sample:

1. C10:0
2. C11:0
3. C12:0
4. C13:0
5. C14:0
6. C15:0
7. C16:0
8. C18:0
9. C18:1 trans 9
10. C18:1 cis 9
11. C18:2 cis 9,12
12. C20:2 cis 11,14

Vs.

Supelco® SP™-2560

B. 100 meter x 0.25 mm x 0.20 μm



Comparative separations may not be representative of all applications.

Pick Your Perfect GC column

Don't settle for less, get more with Zebron™ GC Columns!
Drop in a guaranteed replacement or upgrade to unmatched performance-the choice is yours!

Pick your new column:

GC Column Selection by Dimension p. 20

GC Column Selection by Phase p. 21

GC Column Selection by Application p. 22

GC Column Selection by Manufacturer p. 23

Or:

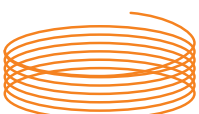
Go online and use our GC Column Match Tool
www.phenomenex.com/FindGC



GC Column Selection by Dimension

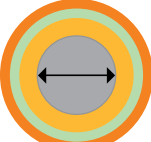
Length

Longer columns can improve resolution, but keep in mind that they will also increase run times. Under isothermal conditions, doubling the column length only increases resolution by 41 %, but doubles the run time. Choose a column length that balances efficiency with acceptable run times.

Short 15 m or less	Good Starting Length 30 m	Long 60 m or more
<p>Applications</p> <ul style="list-style-type: none"> • High boilers • GC-MS applications <p>Advantages</p> <ul style="list-style-type: none"> • Faster run times • Higher temp. limits • Lower bleed • Higher efficiency <p>Disadvantages</p> <ul style="list-style-type: none"> • Less inert • Limited retention 		<p>Applications</p> <ul style="list-style-type: none"> • Complex samples with closely eluting peaks • Low boilers • Less active samples • Complex temperature ramps <p>Advantages</p> <ul style="list-style-type: none"> • Better resolution <p>Disadvantages</p> <ul style="list-style-type: none"> • Slow run times

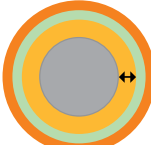
Internal Diameter

Column internal diameter (ID) has a major impact on both resolution and sample capacity. Unlike column length, using smaller ID columns can actually lead to faster run times because the column length required with a small ID is often shorter due to increased efficiency.

Narrow 0.10, 0.18, 0.20 mm	Good Starting ID 0.25 mm	Wide 0.32, or 0.53 mm
<p>Applications</p> <ul style="list-style-type: none"> • Complex samples <p>Advantages</p> <ul style="list-style-type: none"> • Faster run times • Better resolution <p>Disadvantages</p> <ul style="list-style-type: none"> • Lower sample capacity • Easily overloaded 		<p>Applications</p> <ul style="list-style-type: none"> • Dirty samples • Highly concentrated samples <p>Advantages</p> <ul style="list-style-type: none"> • Increased sample capacity • Good for on-column injections <p>Disadvantages</p> <ul style="list-style-type: none"> • Decreased efficiency • May need higher flow rates unsuitable for GC-MS

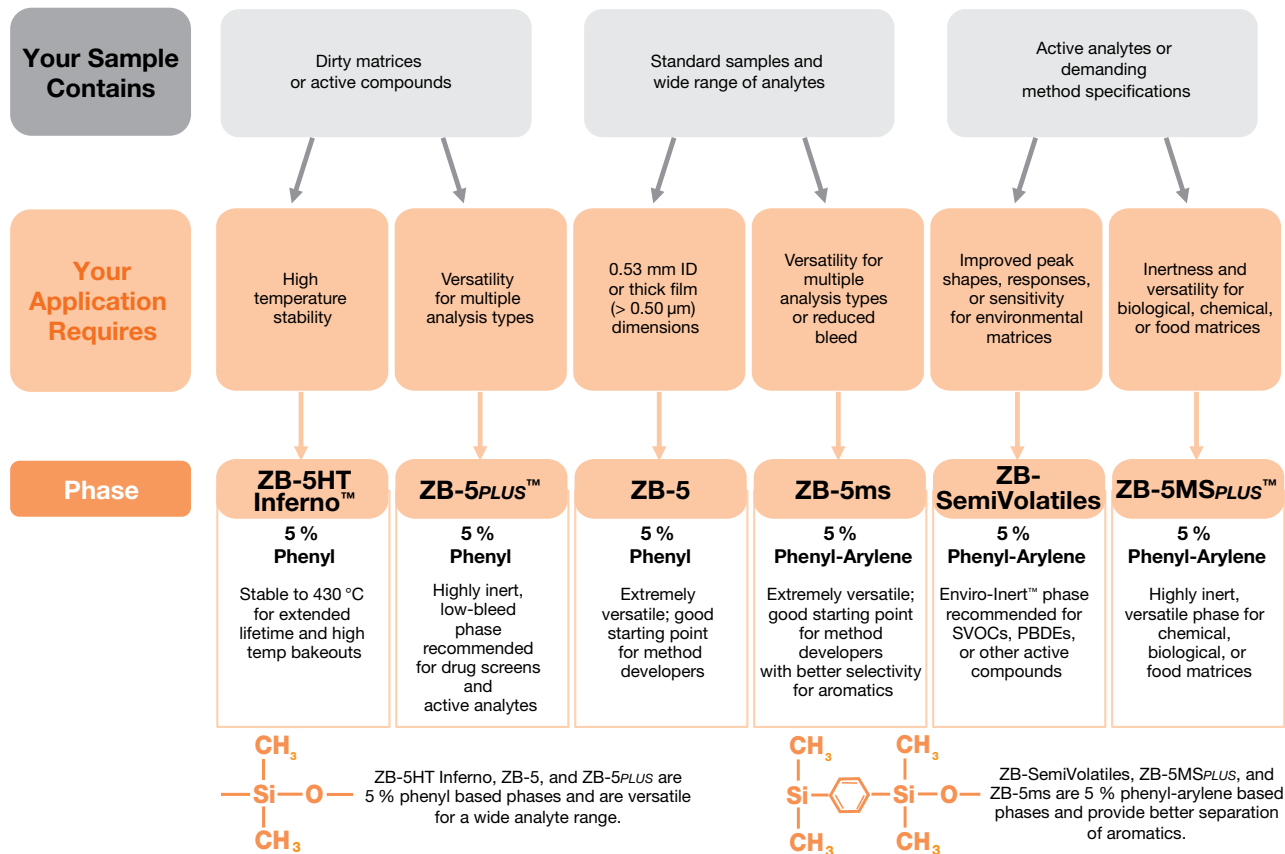
Film Thickness

Film thickness determines retention and plays an important role in column sample capacity. Thin film columns are faster and provide higher resolution, but also lower sample capacity. In most instances, choose the thinnest film possible that still provides adequate retention. When working with active samples, using a slightly thicker film can significantly improve peak shape.

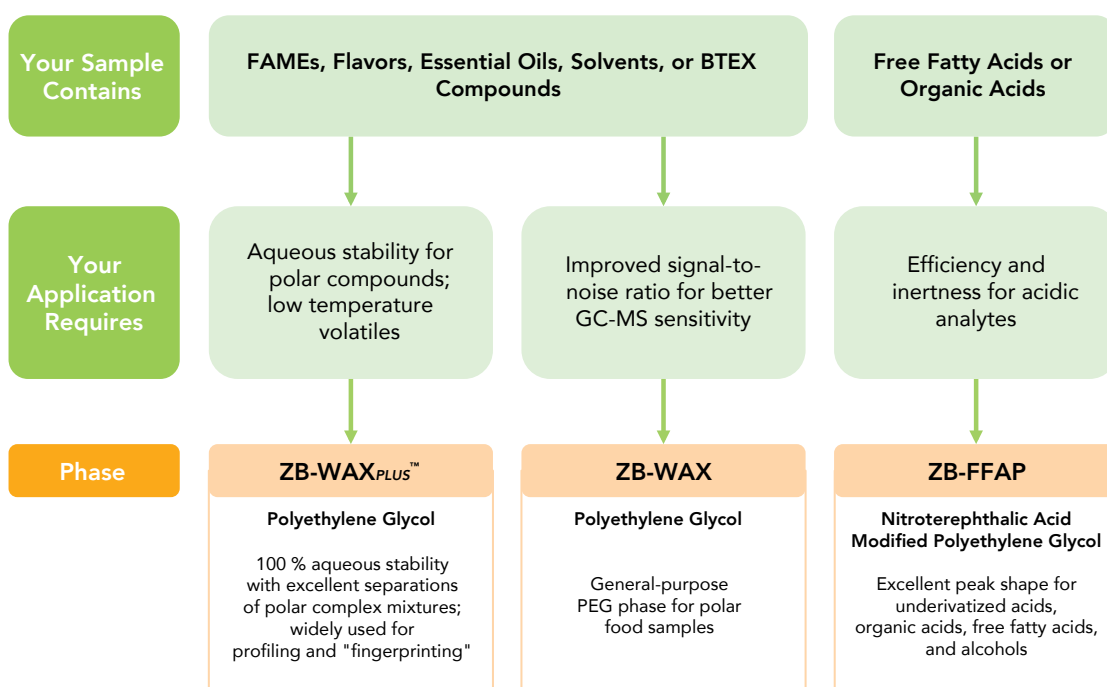
Thin 0.10, 0.18 µm	Good Starting Film 0.25 µm	Thick 0.50 µm or more
<p>Applications</p> <ul style="list-style-type: none"> • High boilers • GC-MS applications <p>Advantages</p> <ul style="list-style-type: none"> • Faster run times • Higher temp. limits • Lower bleed • Higher efficiency <p>Disadvantages</p> <ul style="list-style-type: none"> • Less inert • Limited retention 		<p>Applications</p> <ul style="list-style-type: none"> • Low boilers • Gases, solvents, purgeables, volatiles • Purity testing <p>Advantages</p> <ul style="list-style-type: none"> • Better inertness • Higher capacity <p>Disadvantages</p> <ul style="list-style-type: none"> • Slower run times • Lower temp. limits • Higher bleed

GC Column Selection by Phase

Choosing a "5" Phase (e.g. ZB-5)



Choosing a "PEG" Phase (e.g. ZB-WAX)



GC Column Selection by Application

GC Column Selection by Application

		Essentials							Inferno	Plus	Unlimited																														
		ZB-624	ZB-35	ZB-50	ZB-WAX	ZB-FFAP	ZB-23	ZB-88	ZB-XLB	ZB-5ms	ZB-XLB-HT Inferno™	ZB-5HT Inferno™	ZB-1PLUS™	ZB-5MSPLUS™	ZB-WAXPLUS™	ZB-FAME	ZB-MultiResidue™-1	ZB-MultiResidue™-2	ZB-SemiVolatiles	ZB-Bioethanol																					
Compound Class	Analysis	Recommended Column																																							
Food Safety	Pesticides & Antimicrobials	Multi-Residue Pesticide Screening																																							
		Organochlorine Pesticides in Water																																							
		Organochlorine Pesticides in Foods of Plant Origin																																							
		Organophosphorus Pesticides in Foods of Plant Origin																																							
		Triazine Pesticides in Water																																							
		Triazine Pesticides in Foods of Plant Origin																																							
	Chloramphenicol in Foods of Animal Origin																																								
	Environmental Contaminants	Polybrominated Diphenyl Ethers (PBDEs) in Food																																							
		Polychlorinated Biphenyls (PCBs) in Water																																							
		Polychlorinated Dibenzo-dioxins (PCDDs) in Food																																							
		Polychlorinated Dibenzo-furans (PCDFs) in Food																																							
		Polycyclic Aromatic Hydrocarbons (PAHs) in Water																																							
	Food Contact Materials	Food Packaging Volatiles																																							
		Melamine in Food																																							
		Cyanuric Acid in Food																																							
		Phthalates in Food																																							
		Residual Solvents in Food																																							
		Bisphenol A & F (BPA/BPF) in Food																																							
Additives & Preservatives	Parabens in Food																																								
	Chloropropanols (3-MCPD) in Food																																								
	Flavor Additives (Borneol)																																								
	Phenolic Antioxidants (BHA & BHT) in Food																																								
	Tocopherols in Food																																								
Process Contaminants	Acrylamide in Foods																																								
	Acrylamide, Acrylonitrile, and Acrolein in Water																																								
	Benzene in Food																																								
	Glycols in Food																																								
Hormones	Steroid Hormones in Food																																								
Compound Class		Analysis																				Recommended Column																			
Food Quality	Fats, Oils & FAMES	cis/trans FAMES																																							
		Food Industry FAMES																																							
		Cooking Oil																																							
		Marine Oil																																							
		Free Fatty Acids																																							
		Essential Fatty Acids Omega-3 & -6																																							
	Triglycerides	Butter Triglycerides																																							
		Canola Oil Triglycerides																																							
		Olive Oil Triglycerides																																							
		Peanut Oil Triglycerides																																							
	Alcoholic Beverages	Distilled Liquor Screen																																							
		Ethanol in Beer																																							
		Sulfur in Beer																																							
		Whiskey Compounds																																							
		Wine Compounds																																							
	Other Acids	Amino Acids																																							
	Sterols	Sterols in Lard																																							
		Sterols in Margarine																																							
Sterols in Olive Oil																																									
Sterols in Peanut Butter																																									
Sugars	Alditol Acetates																																								
	Trimethylsilyl (TMS) Sugars																																								
Compound Class		Analysis																				Recommended Column																			
Flavors and Essential Oils	Essential Oils	Ginkgo Biloba Oil																																							
		Lavender Oil																																							
		Peppermint Oil																																							
		Rose Oil																																							
		Spearmint Oil																																							
		Ylang Ylang Oil																																							
	Flavors	Flavors Screening																																							
		Flavor Allergens																																							
		Flavor Volatiles																																							
		Alcoholic Beverage Profile																																							
		Honey Profile																																							
	Fragrances	Fragrance Screening																																							
Fragrance Allergens																																									

GC Column Selection by Manufacturer

Upgrade to Zebron™! Our commitment to quality and innovation is what makes Zebron GC columns well-suited for any application. Performance is GUARANTEED.

Zebron™ Phase	Zebron Composition	Restek®	Agilent®	Supelco®	SGE®	OV
ZB-1	100 % Dimethylpolysiloxane	Rtx®-1, Rtx-1PONA, Rtx-1 F&F	DB®-1, DB-2887, DB-1 EVDX, HP-1, HP-101, HP-PONA, Ultra 1, CP-Sil 5 CB	SPB®-1, SPB-1 TG, SE-30, MET-1, SPB-1 Sulfur, SPB-HAP	BP1, BP1-PONA, BPX1-SimD	OV-1
ZB-1 PLUS™	100 % Dimethylpolysiloxane	Rtx-1ms, Rxi®-1ms	DB-1ms, DB-1ms Ultra Inert, HP-1ms, HP-1ms Ultra Inert, CP-Sil 5 CB MS, VF-1ms	MDN-1, Equity®-1	SolGel-1ms™	OV-1ms
ZB-1HT Inferno™	100 % Dimethylpolysiloxane	Rxi-1HT	DB-1ht, CP-SimDist	Petrocol 2887		
ZB-5	5 % Phenyl 95 % Dimethylpolysiloxane	Rtx-5	DB-5, HP-5, Ultra 2, HP-PAS-5, CP-Sil 8 CB	MDN-5, SPB-5, PTE-5, SE-54, PTA-5, Equity-5, Sac-5	BP5, BPX5	OV-5
ZB-5 PLUS™	5 % Phenyl 95 % Dimethylpolysiloxane	Rtx-5ms, Rxi-5ms, Rtx-5Amine	DB-5, HP-5ms, HP-5msi	MDN-5S		
ZB-5HT Inferno™	5 % Phenyl 95 % Dimethylpolysiloxane	Rxi-5HT, Rtx-5HT, Stx®-5HT, XTI®-5HT	DB-5ht, VF-5ht	HT-5		
ZB-5ms	5 % Phenyl-Arylene 95 % Dimethylpolysiloxane	Rtx-5Sil MS, Rxi-5Sil MS	DB-5ms, DB-5.625, DB-5ms EVDX, VF-5ms, CP-Sil 8 CB MS			
ZB-5MS PLUS™	5 % Phenyl-Arylene 95 % Dimethylpolysiloxane	Rxi-5Sil MS	DB-5ms Ultra Inert, HP-5ms Ultra Inert, DB-5ms, VF-5ms	SLB®-5ms		
ZB-SemiVolatiles	5 % Phenyl-Arylene 95 % Dimethylpolysiloxane	Rxi-5Sil MS, Rxi-5ms	DB-5ms Ultra Inert, HP-5ms Ultra Inert	SLB®-5ms		
ZB-35	35 % Phenyl 65 % Dimethylpolysiloxane	Rtx-35, Rtx-35ms	DB-35, DB-35ms, HP-35, HP-35ms	MDN-35, SPB-35, SPB-608	BPX35, BPX608	OV-35
ZB-35HT Inferno™	35 % Phenyl 65 % Dimethylpolysiloxane			Phenomenex Exclusive		
ZB-50	50 % Phenyl 50 % Dimethylpolysiloxane	Rtx-50	DB-17, DB-17HT, DB-17ms, DB-17 EVDX, HP-50+, CP-Sil 24 CB	SP-2250, SPB-17, SPB-50	BPX50	OV-17
ZB-624	6 % Cyanopropylphenyl 94 % Dimethylpolysiloxane	Rtx-1301, Rtx-624	DB-1301, DB-624, DB-VRX, HP-VOC, CP-1301, CP-Select 624 CB	SPB-1301, SPB-624	BP624	OV-624 OV-1301
ZB-23	50 % Cyanopropyl 50 % Methylpolysiloxane	Rtx-2330	DB-23	SP-2330, SP-2340	AT-Silar	BPX-70
ZB-88	88 % Cyanopropyl 12 % Aryl-polysiloxane	Rt®-2560	CP-Sil 88, HP-88	SP-2560, SP-2340, SP-2330		
ZB-FAME	bis-cyanopropyl		CP-Select CB for FAME	SP-2560, SP-2340, SP-2330	BPX-70, BPX-90	
ZB-WAX	Polyethylene Glycol	Rtx-WAX, Famewax, Stabilwax-DB	DB-WAXetr, HP-INNOWax, CP-Wax 57 CB	MET-Wax, Omegawax	SolGel-WAX™	Carbowax 20M
ZB-WAX PLUS™	Polyethylene Glycol	Stabilwax®	DB-WAX, CAM, HP-20M, Carbowax 20M, CP-Wax 52 CB	SUPELCO WAX® 10	BP20	Carbowax 20M
ZB-FFAP	Nitroterephthalic Acid Modified Polyethylene Glycol	Stabilwax-DA	DB-FFAP, HP-FFAP, CP-Wax 58 FFAP CB, CP-FFAP CB	Nukol, SPB-1000	BP21	OV-351
ZB-MultiResidue™-1	Proprietary	Rtx-CLPesticides, Stx-CLPesticides				
ZB-MultiResidue-2	Proprietary	Rtx-CLPesticides2, Stx-CLPesticides2				
ZB-PAH	Proprietary	Rti-PAH	DB-EUPAH			
ZB-XLB	Proprietary	Rtx-XLB	DB-XLB, VF-XMS	MDN-12		
ZB-XLB-HT Inferno	Proprietary			Phenomenex Exclusive		
ZB-Bioethanol	Proprietary			Phenomenex Exclusive		

This section is, neither in terms of manufacturers nor in terms of their products, a complete list, and the accuracy of the data is not guaranteed. Small differences in dimensions or performance might be possible and slight adjustments to your application may be necessary.



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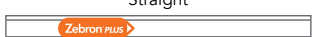
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GC Inlet Liner Ordering Information

Zebtron™ PLUS GC Liners

Description	Application	Inlet Style	Dimensions ID x L (mm)	Deactivation	Part No.	Unit
For Agilent® and Thermo Scientific® GC Systems						
 Direct Connect	Trace analysis, Splitless injections	S/SL	4 x 78.5	PLUS Inert	AG2-0A50-01 AG2-0A50-05 AG2-0A50-25	Ea 5/pk 25/pk
 Single Taper	Pesticides	S/SL	4 x 78.5	PLUS Inert	AG2-0A10-01 AG2-0A10-05 AG2-0A10-25	Ea 5/pk 25/pk
 Single Taper Z-Liner™	Semi-volatiles, Dirty samples	S/SL	4 x 78.5	PLUS Inert	AG2-0A13-01 AG2-0A13-05 AG2-0A13-25	Ea 5/pk 25/pk
 Single Taper with Wool	Semi-volatiles	S/SL	4 x 78.5	PLUS Inert	AG2-0A11-01 AG2-0A11-05 AG2-0A11-25	Ea 5/pk 25/pk
 Straight	Volatiles	S/SL	4 x 78.5	PLUS Inert	AG2-0A00-01 AG2-0A00-05 AG2-0A00-25	Ea 5/pk 25/pk
 Straight Z-Liner	Dirty samples, Volatiles, High initial oven temperatures	S/SL	4 x 78.5	PLUS Inert	AG2-0A03-01 AG2-0A03-05 AG2-0A03-25	Ea 5/pk 25/pk
 Straight Single Baffle	Semi-volatiles, Pesticides	S/SL	1.8 x 71	PLUS Inert	AG2-1F06-01 AG2-1F06-05 AG2-1F06-25	Ea 5/pk 25/pk
For Shimadzu® 17A, 2014 and 2025 Models						
 Single Taper Z-Liner™	Pesticides	S/SL	3.4 x 95	PLUS Inert	AG2-3B13-01 AG2-3B13-05 AG2-3B13-25	Ea 5/pk 25/pk
 Straight Z-Liner	Volatiles, Dirty samples, High initial oven temperatures	S/SL	3.4 x 95	PLUS Inert	AG2-3B03-01 AG2-3B03-05 AG2-3B03-25	Ea 5/pk 25/pk
For Shimadzu 2010 Models						
 Single Taper	Volatiles, Dirty samples, High initial oven temperatures	S/SL	3.4 x 95	PLUS Inert	AG2-4B10-01 AG2-4B10-05 AG2-4B10-25	Ea 5/pk 25/pk
 Single Taper Z-Liner	Pesticides	S/SL	3.4 x 95	PLUS Inert	AG2-4B13-01 AG2-4B13-05 AG2-4B13-25	Ea 5/pk 25/pk
 Straight	Volatiles	S/SL	3.4 x 95	PLUS Inert	AG2-4B00-01 AG2-4B00-05 AG2-4B00-25	Ea 5/pk 25/pk
 Straight Z-Liner	Volatiles, Dirty samples, High initial oven temperatures	S/SL	3.4 x 95	PLUS Inert	AG2-4B03-01 AG2-4B03-05 AG2-4B03-25	Ea 5/pk 25/pk
For PerkinElmer® GC Systems						
 Single Taper	Pesticides	S/SL	4 x 92	PLUS Inert	AG2-2A10-01 AG2-2A10-05 AG2-2A10-25	Ea 5/pk 25/pk
 Single Taper Z-Liner™	Semi-volatiles, Dirty samples	S/SL	4 x 92	PLUS Inert	AG2-2A13-01 AG2-2A13-05 AG2-2A13-25	Ea 5/pk 25/pk
 Straight	Volatiles	S/SL	4 x 92	PLUS Inert	AG2-2A00-01 AG2-2A00-05 AG2-2A00-25	Ea 5/pk 25/pk
 Straight Z-Liner	Volatiles, Dirty samples	PSS	2 x 86.2	PLUS Inert	AG2-2E03-01 AG2-2E03-05 AG2-2E03-25	Ea 5/pk 25/pk
 Straight Z-Liner	High initial oven temperatures	S/SL	4 x 92	PLUS Inert	AG2-2A03-01 AG2-2A03-05 AG2-2A03-25	Ea 5/pk 25/pk

GC Column Ordering Information

Zebtron™ ZB-88

Length (m)	ID (mm)	df (µm)	Temp. Limits (°C)	Part No.
30	0.25	0.20	0 to 250/260	7HG-G037-10
60	0.25	0.20	0 to 250/260	7KG-G037-10
100	0.25	0.20	0 to 250/260	7MG-G037-10

Zebtron ZB-23

Length (m)	ID (mm)	df (µm)	Temp. Limits (°C)	Part No.
15	0.25	0.25	40 to 250/260	7EG-G039-11
15	0.53	0.50	40 to 230/240	7EK-G039-17
20	0.18	0.20	40 to 250/260	7FD-G039-10
30	0.25	0.15	40 to 250/260	7HG-G039-05
30	0.25	0.25	40 to 250/260	7HG-G039-11
30	0.32	0.25	40 to 250/260	7HM-G039-11
30	0.53	0.50	40 to 230/240	7HK-G039-17
60	0.25	0.15	40 to 250/260	7KG-G039-05
60	0.25	0.25	40 to 250/260	7KG-G039-11
60	0.32	0.25	40 to 250/260	7KM-G039-11

Zebtron ZB-FAME

Length (m)	ID (mm)	df (µm)	Temp. Limits (°C)	Part No.
20	0.18	0.15	-20 to 280	7FD-G033-05
30	0.25	0.20	-20 to 280	7HG-G033-10
60	0.25	0.20	-20 to 280	7KG-G033-10

Zebtron ZB-5HT Inferno™

Length (m)	ID (mm)	df (µm)	Temp. Limits (°C)	Part No.
15	0.25	0.10	-60 to 400/430	7EG-G015-02
15	0.25	0.25	-60 to 400/430	7EG-G015-11
15	0.32	0.10	-60 to 400/430	7EM-G015-02
15	0.32	0.25	-60 to 400/430	7EM-G015-11
15	0.53	0.15	-60 to 400	7EK-G015-05
20	0.18	0.18	-60 to 400/430	7FD-G015-08
30	0.25	0.10	-60 to 400/430	7HG-G015-02
30	0.25	0.25	-60 to 400/430	7HG-G015-11
30	0.32	0.10	-60 to 400/430	7HM-G015-02
30	0.32	0.25	-60 to 400/430	7HM-G015-11
30	0.53	0.15	-60 to 400	7HK-G015-05
60	0.25	0.25	-60 to 400/430	7KG-G015-11

Note: If you need a 5 in. cage, simply add a (-B) after the part number, e.g., 7HG-G015-11-B. Some exceptions may apply. Agilent 6850 and some SRI and process GC systems use only 5 in. cages.

Zebtron ZB-1PLUS™

Length (m)	ID (mm)	df (µm)	Temp. Limits (°C)	Part No.
10	0.10	0.10	-60 to 360/370	7CB-G031-02
10	0.18	0.18	-60 to 360/370	7CD-G031-08
12	0.20	0.33	-60 to 360/370	7DE-G031-14
15	0.25	0.25	-60 to 360/370	7EG-G031-11
20	0.18	0.18	-60 to 360/370	7FD-G031-08
25	0.20	0.33	-60 to 360/370	7GE-G031-14
30	0.25	0.10	-60 to 360/370	7HG-G031-02
30	0.25	0.25	-60 to 360/370	7HG-G031-11
30	0.25	0.50	-60 to 360/370	7HG-G031-17
30	0.25	1.00	-60 to 360/370	7HG-G031-22
30	0.32	0.25	-60 to 360/370	7HM-G031-11
30	0.32	1.00	-60 to 360/370	7HM-G031-22
30	0.53	1.00	-60 to 360/370	7HK-G031-22
60	0.25	0.25	-60 to 360/370	7KG-G031-11
60	0.25	1.00	-60 to 360/370	7KG-G031-22
60	0.32	1.00	-60 to 360/370	7KM-G031-22

Note: If you need a 5 in. cage, simply add a (-B) after the part number, e.g., 7HG-G011-11-B. Some exceptions may apply. Agilent 6850 and some SRI and process GC systems use only 5 in. cages.

Zebtron ZB-WAXPLUS™

Length (m)	ID (mm)	df (µm)	Temp. Limits (°C)	Part No.
10	0.10	0.10	20 to 250/260	7CB-G013-02
15	0.25	0.25	20 to 250/260	7EG-G013-11
15	0.53	1.00	20 to 230/240	7EK-G013-22
20	0.18	0.18	20 to 250/260	7FD-G013-08
30	0.25	0.25	20 to 250/260	7HG-G013-11
30	0.25	0.50	20 to 250/260	7HG-G013-17
30	0.32	0.25	20 to 250/260	7HM-G013-11
30	0.32	0.50	20 to 250/260	7HM-G013-17
30	0.32	1.00	20 to 230/240	7HM-G013-22
30	0.53	1.00	20 to 230/240	7HK-G013-22
60	0.25	0.15	20 to 250/260	7KG-G013-05
60	0.25	0.25	20 to 250/260	7KG-G013-11
60	0.25	0.50	20 to 250/260	7KG-G013-17
60	0.32	0.25	20 to 250/260	7KM-G013-11
60	0.32	0.50	20 to 250/260	7KM-G013-17
60	0.53	1.00	20 to 230/240	7KK-G013-22

Note: If you need a 5 in. cage, simply add a (-B) after the part number, e.g., 7HG-G013-11-B. Some exceptions may apply. Agilent 6850 and some SRI and process GC systems use only 5 in. cages.

Zebtron ZB-FFAP

Length (m)	ID (mm)	df (µm)	Temp. Limits (°C)	Part No.
15	0.25	0.25	40 to 250/260	7EG-G009-11
15	0.32	0.25	40 to 250/260	7EM-G009-11
15	0.32	0.50	40 to 250/260	7EM-G009-17
15	0.53	1.00	40 to 250/260	7EK-G009-22
30	0.25	0.25	40 to 250/260	7HG-G009-11
30	0.32	0.25	40 to 250/260	7HM-G009-11
30	0.32	0.50	40 to 250/260	7HM-G009-17
30	0.32	1.00	40 to 250/260	7HM-G009-22
30	0.53	1.00	40 to 250/260	7HK-G009-22
50	0.32	0.50	40 to 250/260	7JM-G009-17
60	0.25	0.25	40 to 250/260	7KG-G009-11

Note: If you need a 5 in. cage, simply add a (-B) after the part number, e.g., 7HG-G009-11-B. Some exceptions may apply. Agilent 6850 and some SRI and process GC systems use only 5 in. cages.

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Australia

t: +61 (0)2-9428-6444
f: +61 (0)2-9428-6445
auiinfo@phenomenex.com

Austria

t: +43 (0)1-319-1301
f: +43 (0)1-319-1300
anfrage@phenomenex.com

Belgium

t: +32 (0)2 503 4015 (French)
t: +32 (0)2 511 8666 (Dutch)
f: +31 (0)30-2383749
beinfo@phenomenex.com

Canada

t: +1 (800) 543-3681
f: +1 (310) 328-7768
info@phenomenex.com

China

t: +86 400-606-8099
f: +86 (0)22 2532-1033
phen@agela.com

Denmark

t: +45 4824 8048
f: +45 4810 6265
nordicinfo@phenomenex.com

Finland

t: +358 (0)9 4789 0063
f: +45 4810 6265
nordicinfo@phenomenex.com

France

t: +33 (0)1 30 09 21 10
f: +33 (0)1 30 09 21 11
franceinfo@phenomenex.com

Germany

t: +49 (0)6021-58830-0
f: +49 (0)6021-58830-11
anfrage@phenomenex.com

India

t: +91 (0)40-3012 2400
f: +91 (0)40-3012 2411
indiainfo@phenomenex.com

Ireland

t: +353 (0)1 247 5405
f: +44 1625-501796
eireinfo@phenomenex.com

Italy

t: +39 051 6327511
f: +39 051 6327555
italiainfo@phenomenex.com

Luxembourg

t: +31 (0)30-2418700
f: +31 (0)30-2383749
nlinfo@phenomenex.com

Mexico

t: 01-800-844-5226
f: 001-310-328-7768
tecnicomx@phenomenex.com

The Netherlands

t: +31 (0)30-2418700
f: +31 (0)30-2383749
nlinfo@phenomenex.com

New Zealand

t: +64 (0)9-4780951
f: +64 (0)9-4780952
nzinfo@phenomenex.com

Norway

t: +47 810 02 005
f: +45 4810 6265
nordicinfo@phenomenex.com

Portugal

t: +351 221 450 488
f: +34 91-413-2290
ptinfo@phenomenex.com

Spain

t: +34 91-413-8613
f: +34 91-413-2290
espinfo@phenomenex.com

Sweden

t: +46 (0)8 611 6950
f: +45 4810 6265
nordicinfo@phenomenex.com

Switzerland

t: +41 61 692 20 20
f: +41 61 692 20 22
swissinfo@phenomenex.com

United Kingdom

t: +44 (0)1625-501367
f: +44 (0)1625-501796
ukinfo@phenomenex.com

USA

t: +1 (310) 212-0555
f: +1 (310) 328-7768
info@phenomenex.com

All other countries Corporate Office USA

t: +1 (310) 212-0555
f: +1 (310) 328-7768
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