Analyzing Fats and Oils by GC

phenomenex®

. . . breaking with tradition℠

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 Zebron™ 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

Essential Oils by GC-MS

Sterols by GC-FID

Triglycerides by GC-FID

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Essential Oils
by GC-MS

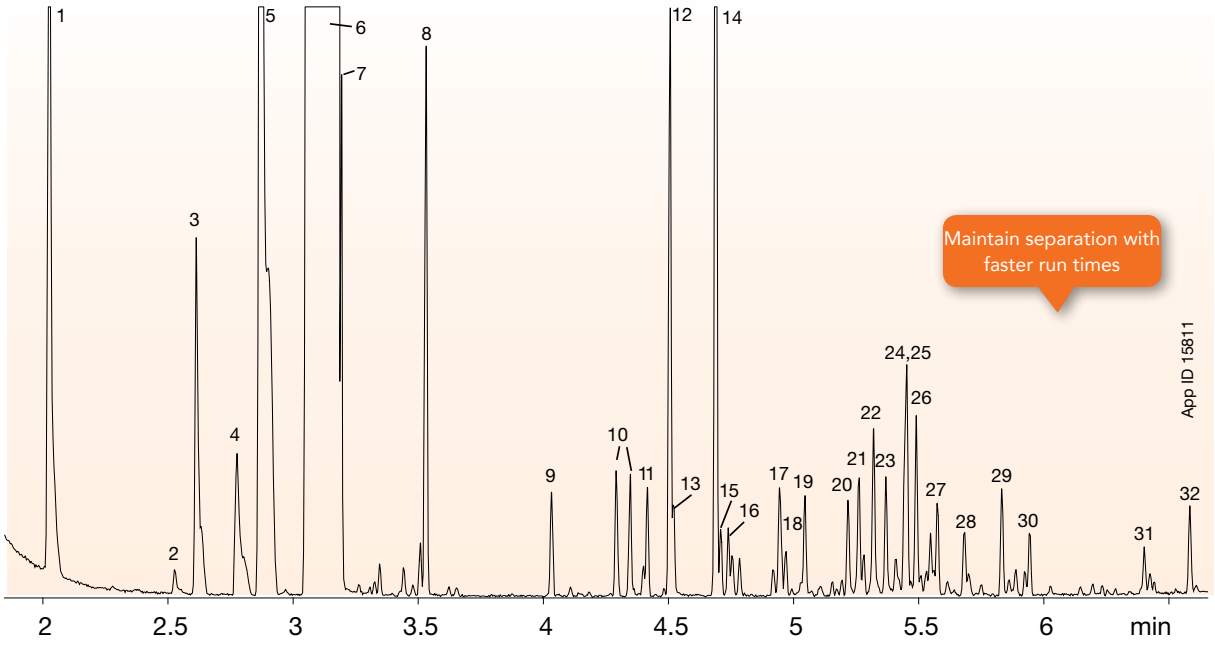
Essential oils are fragrant plant essences primarily composed of terpenes, their derivatives, and other aromatic compounds. Variation in plant locations and growing conditions produces natural differences in essential oil components, and due to their high price, premium oils are subject to adulteration 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: Zebron™ 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: Zebron 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. Gerenial
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

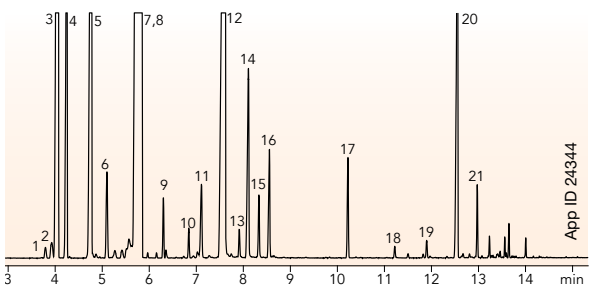


Essential Oils
by GC-MS

Rosemary Oil

Column: Zebron™ ZB-1*PLUS*
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

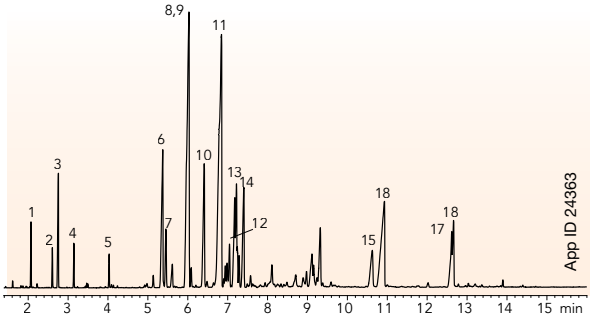
1. Tricyclene
2. α-Thujene
3. α-Pinene
4. Camphene
5. β-Pinene
6. β-Myrcene
7. Eucalyptol
8. Limonene
9. γ-Terpinene
10. Terpinolene
11. Linalool
12. Camphor
13. Isoborneol
14. Borneol
15. 4-Terpineol
16. Terpineol
17. Bornyl Acetate
18. Eugenol
19. Copaene
20. Caryophyllene
21. α-Caryophyllene



Ylang Ylang Oil

Column: Zebron ZB-1*PLUS*
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

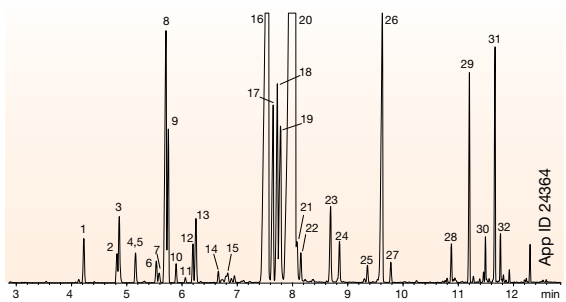
1. p-Methyl Anisole
2. Methyl Benzoate
3. Linalool
4. Benzyl Acetate
5. Geraniol
6. Geranyl Acetate
7. Copaene
8. β-Caryophyllene
9. Cinnamyl Acetate
10. Humulene
11. Germacrene
12. α-Amorphene
13. Farnasene
14. δ-Cadinene
15. Farnesol
16. Benzyl Benzoate
17. Benzyl Salicylate
18. Farnesyl Acetate



Peppermint Oil

Column: Zebron ZB-1*PLUS*
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

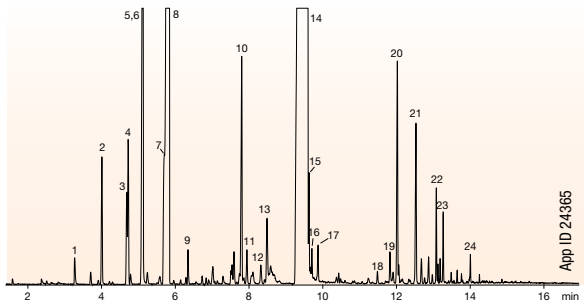
1. α-Pinene
2. Sabinene
3. β-Pinene
4. β-Myrcene
5. 3-Octanol
6. α-Terpenene
7. Cymene
8. Eucalyptol
9. δ-Limonene
10. cis-Ocimene
11. trans-Ocimene
12. γ-Terpinene
13. cis-Sabinene Hydrate
14. β-Terpineol
15. Linalool
16. Menthone
17. Isomenthone
18. Menthofuran
19. Neomenthol
20. Menthol
21. Neoisomenthol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



Spearmint Oil

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



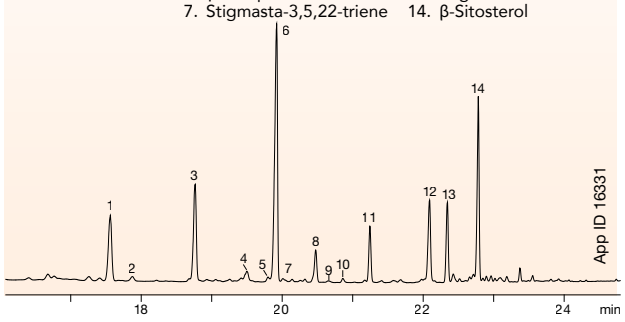
Sterols
by GC-FID

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

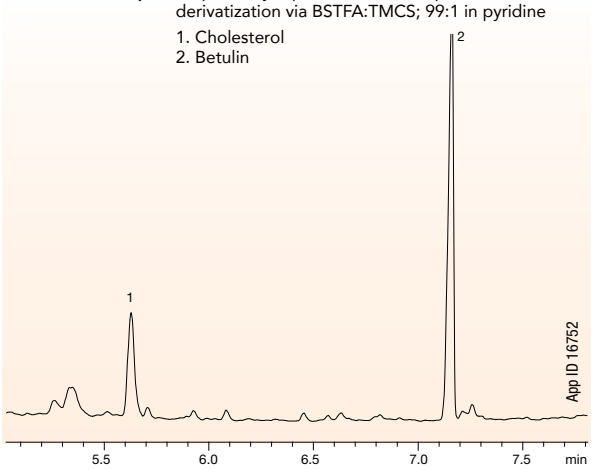
1. Squalene
2. Lignoceric acid
3. δ-Tocopherol
4. δ-Tocomonoenol
5. Campesta-3,5-diene
6. γ-Tocopherol
7. Stigmasta-3,5,22-triene
8. γ-Tocomonoenol
9. Stigmasta-3,5-diene
10. Cholesterol
11. α-Tocopherol
12. Campesterol
13. Stigmasterol
14. β-Sitosterol



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

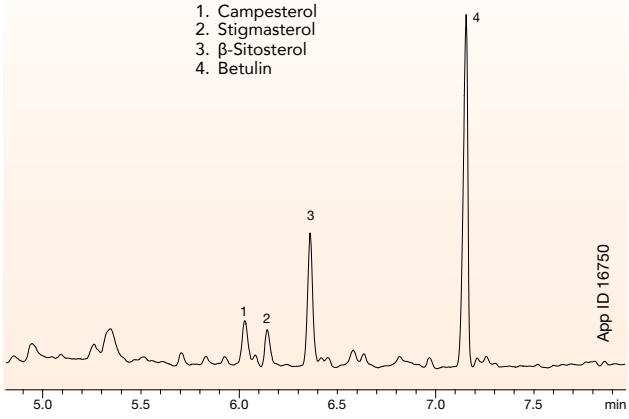
1. Cholesterol
2. Betulin



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

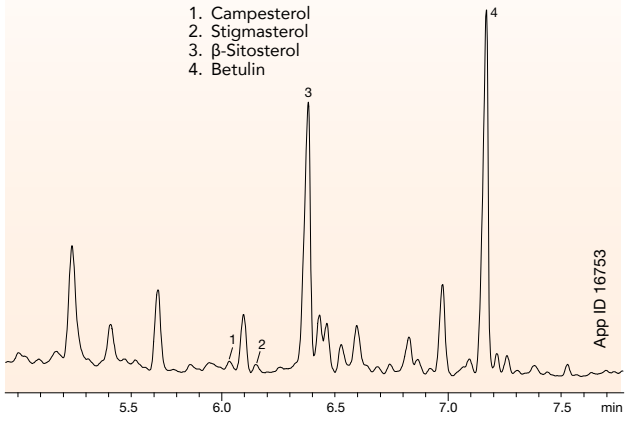
1. Campesterol
2. Stigmasterol
3. β-Sitosterol
4. Betulin



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

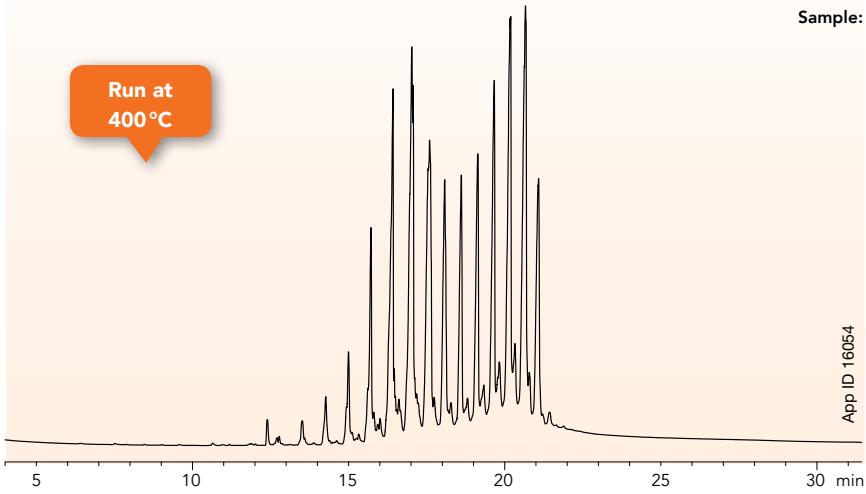


Triglycerides
by GC-FID

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 Zebron™ ZB-5HT Inferno™ GC column, which is specifically designed to withstand high oven temperatures.

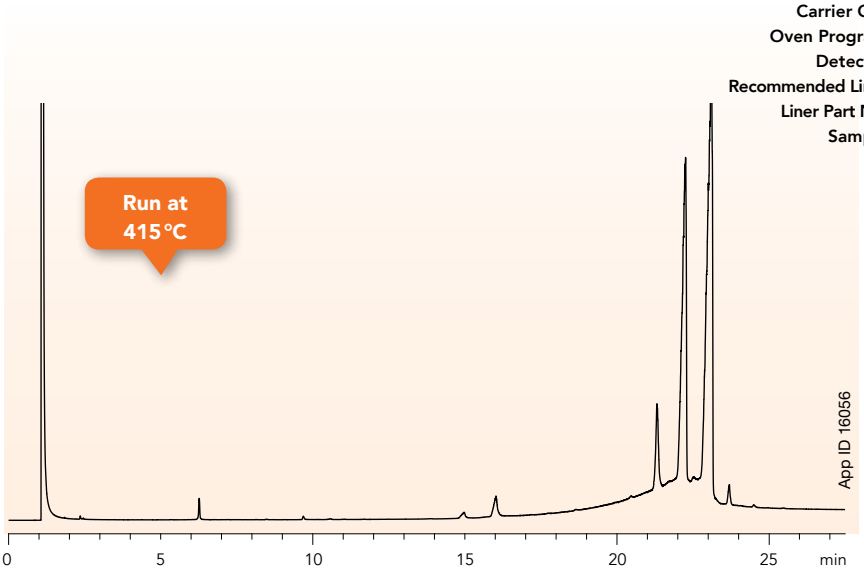
Butter Triglycerides

Column: Zebron 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: Zebron PLUS Direct Connect Liner
Liner Part No.: AG2-0A50-05 (for Agilent® System)
Sample: Butter Triglycerides



Olive Oil Triglycerides

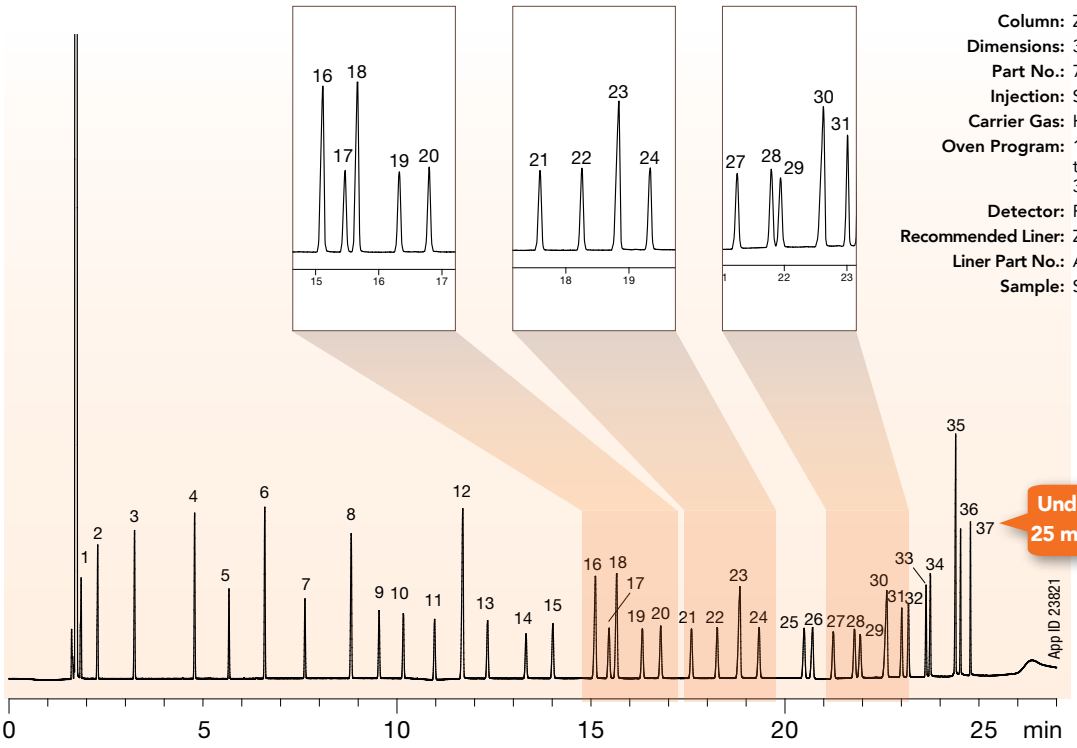
Column: Zebron ZB-5HT Inferno
Dimensions: 30 meter x 0.25 mm x 0.10 µm
Part No.: 7HG-G015-02
Injection: On-Column @ 223 °C, 0.1 µL
Carrier Gas: Helium @ 1 mL/min (constant flow)
Oven Program: 220 °C for 1 min to 400 °C @ 8 °C/min for 4 min
Detector: FID @ 415 °C
Recommended Liner: Zebron PLUS Direct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



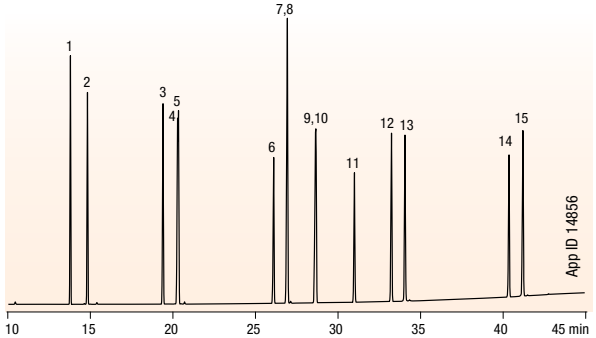
Column: Zebron™ ZB-FAME
Dimensions: 30 meter x 0.25 mm x 0.20 µm
Part No.: 7HG-G033-10
Injection: Split 50:1 @ 240 °C, 1 µL
Carrier Gas: Helium @ 1.2 mL/min (constant flow)
Oven Program: 100 °C for 2 min to 140 °C @ 10 °C/min to 190 °C @ 3 °C/min to 260 °C @ 30 °C/min for 2 min
Detector: FID @ 260 °C
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)
Sample:

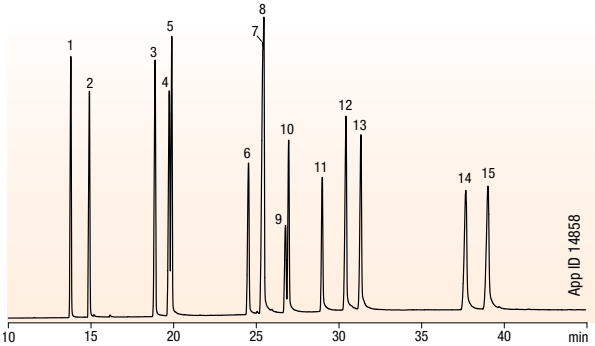
1. Methyl Myristate
2. Methyl Myristoleate
3. Methyl Palmitate
4. Methyl Palmitelaidate
5. Methyl Palmitoleate
6. Methyl Stearate
7. Methyl Oleate
8. Methyl Elaidate
9. Methyl Linoleate
10. Methyl Linelaidate
11. Methyl Linolenate
12. Methyl Arachidate
13. Methyl Gondonate
14. Methyl Behenate
15. Methyl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



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)
Sample:

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

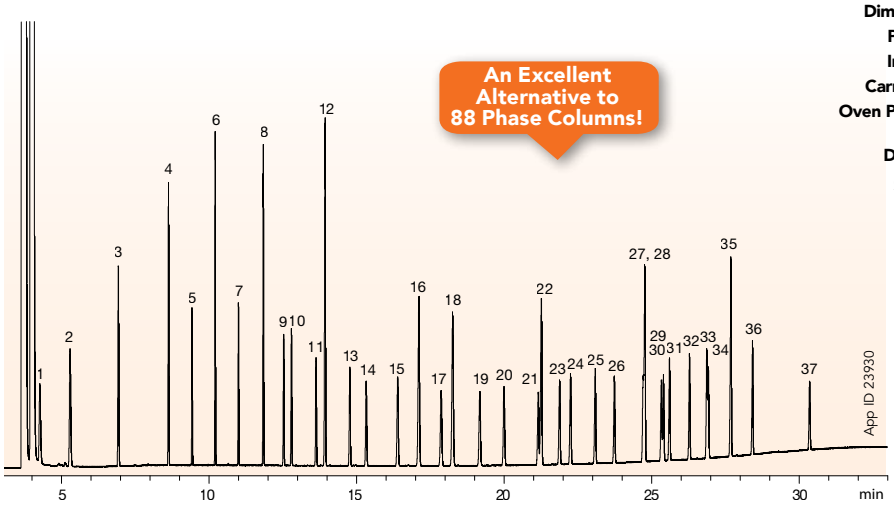


Fatty Acids and FAMEs
by GC-FID

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



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

Omega-3 Fatty Acids and Fish Oil

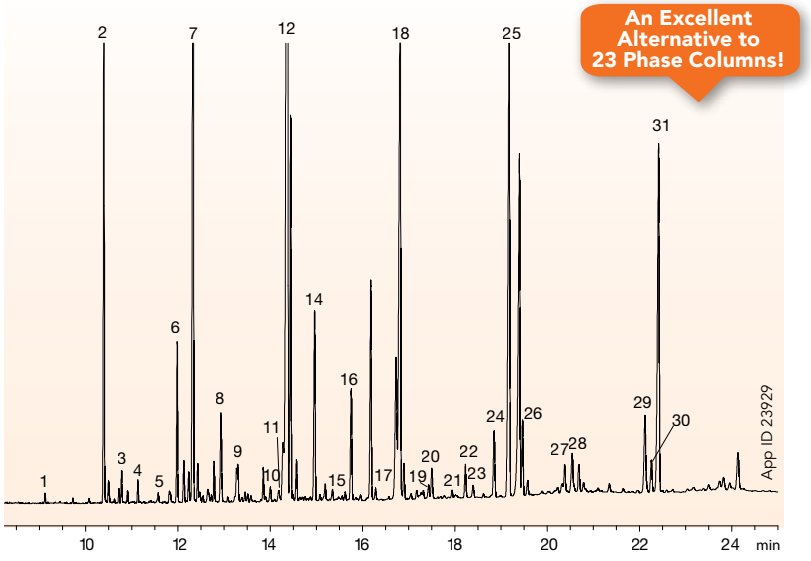
- Recommended alternative to Supelco® SP™-2330, Agilent® DB®-23, and Restek® Rtx®-2330
- Alternate selectivity well suited for marine oils

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

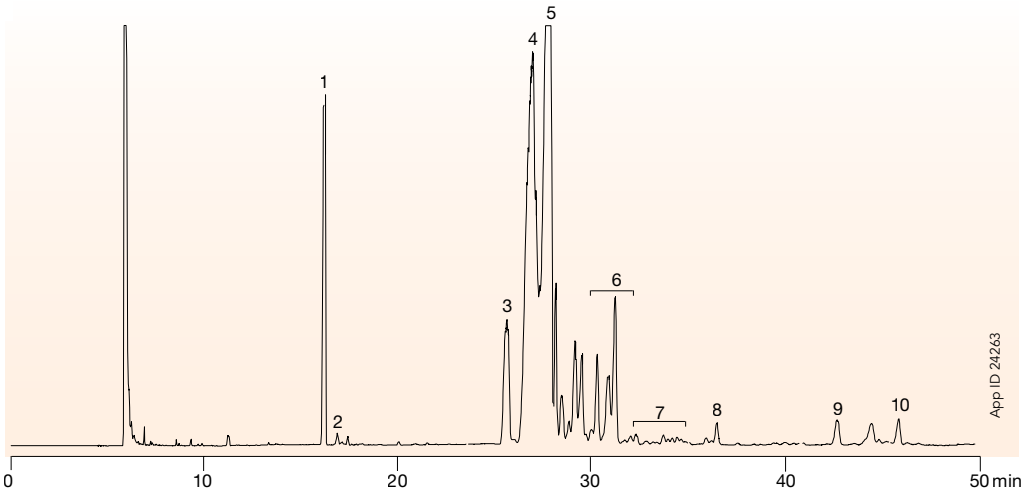
Unsaturated Fatty Acids from Marine Oil



Fatty Acids and FAMEs
by GC-FID

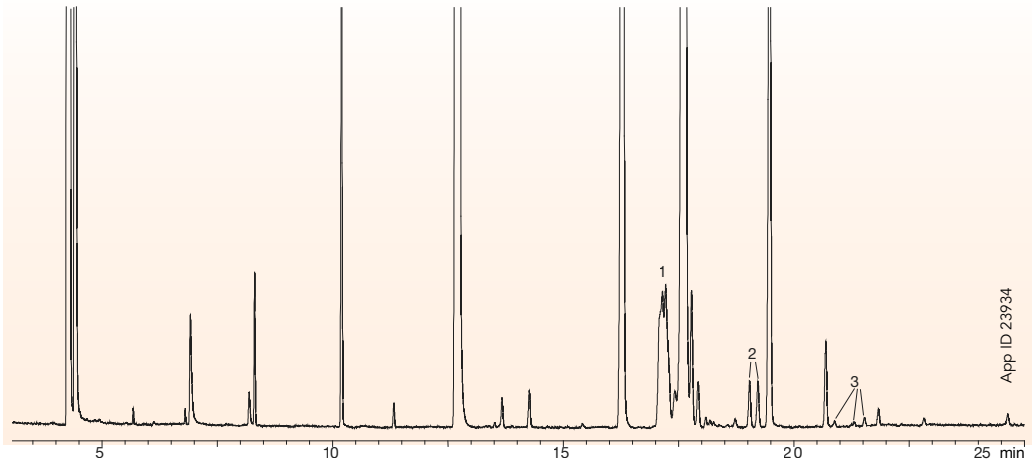
FAMEs in Canola Oil Margarine

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

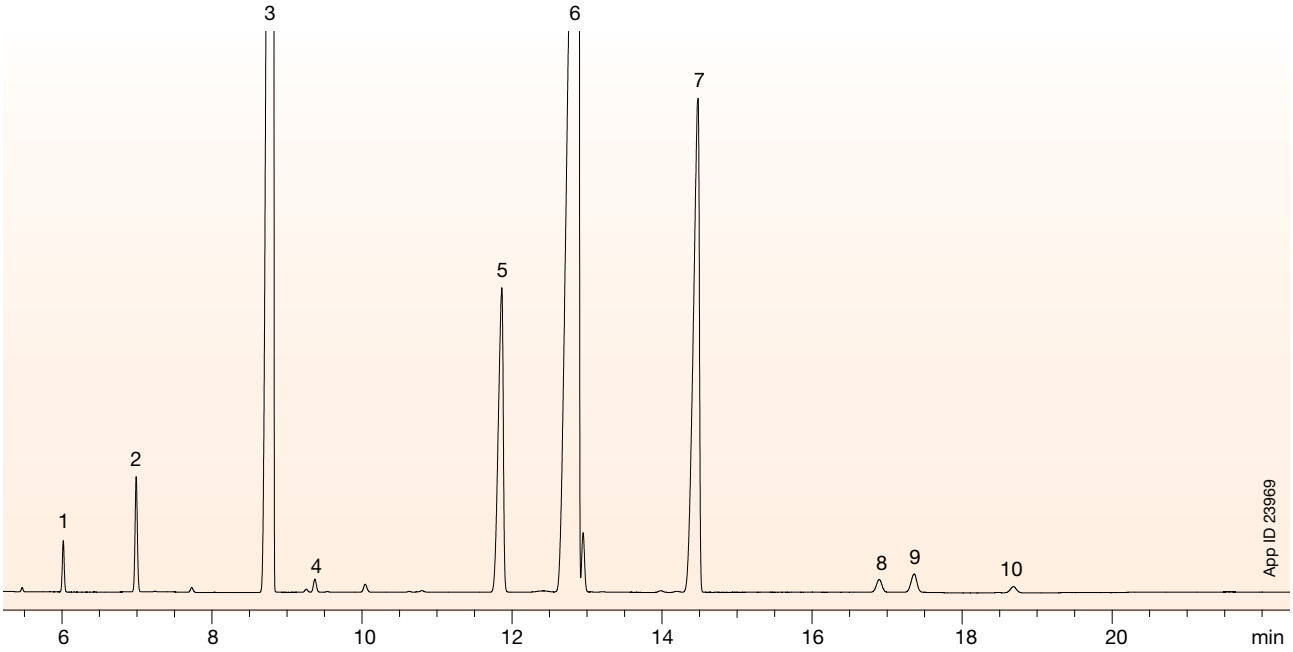


Fatty Acids and FAMES
by GC-FID

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.



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

Olive Oil

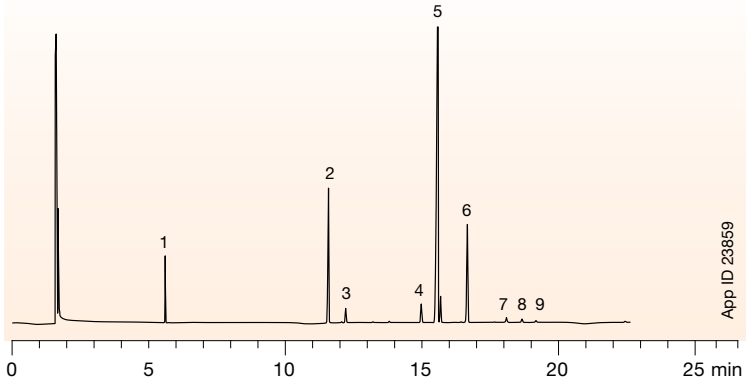
One of the most popular applications around the world has been optimized using Zebron™ ZB-FAME! The high-cyano phase chemistry meets requirements for IOC olive oil testing methods, while providing an opportunity for improved productivity. Achieve great results on ZB-FAME using the standard 60 meter dimension – 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)

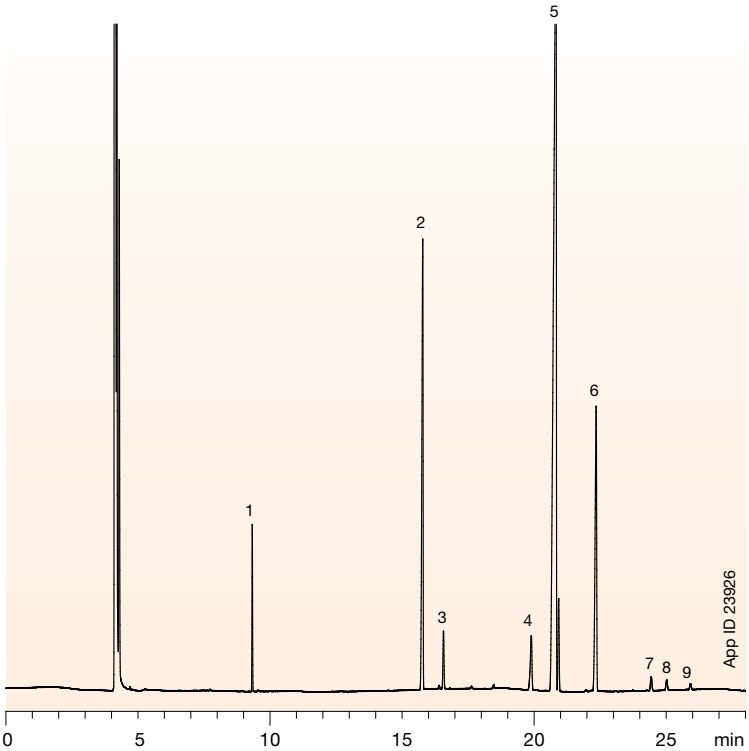


Extraction and Derivatization Protocol:

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: 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. 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

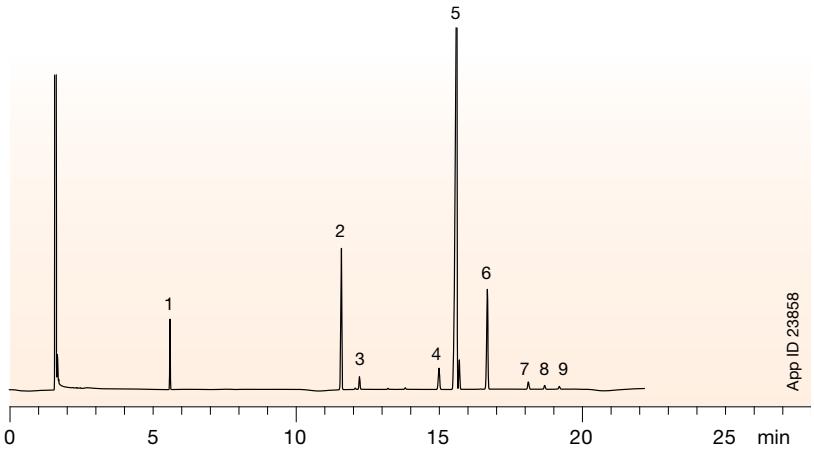
*internal standard

Fatty Acids and FAMES
by GC-FID

Extra Virgin Olive Oil

Reduce run times with a 30 meter column!

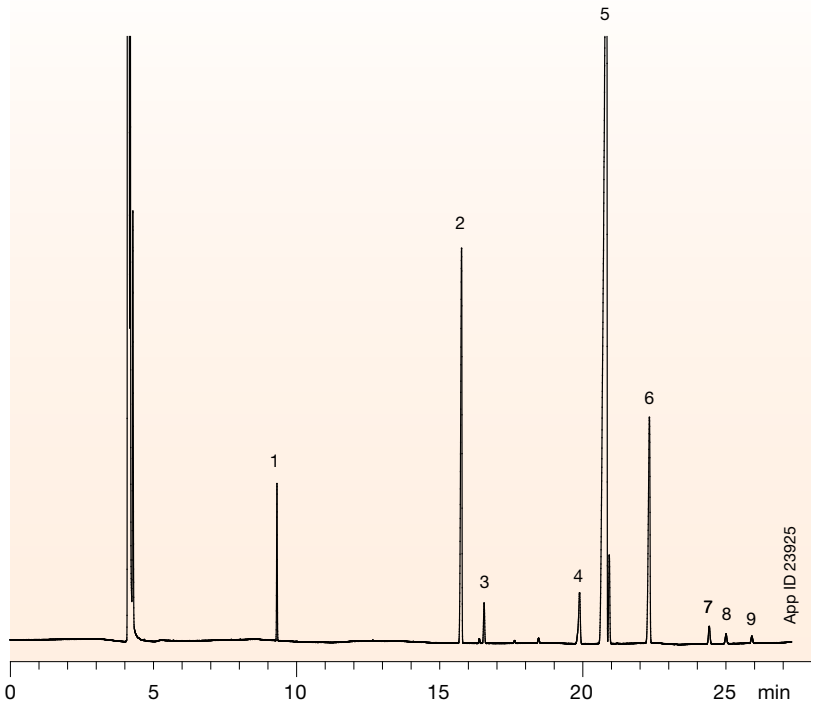
A. Zebron™ ZB-FAME
30 meter x 0.25 mm x 0.20 µm (Part No. 7HG-G033-10)



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:

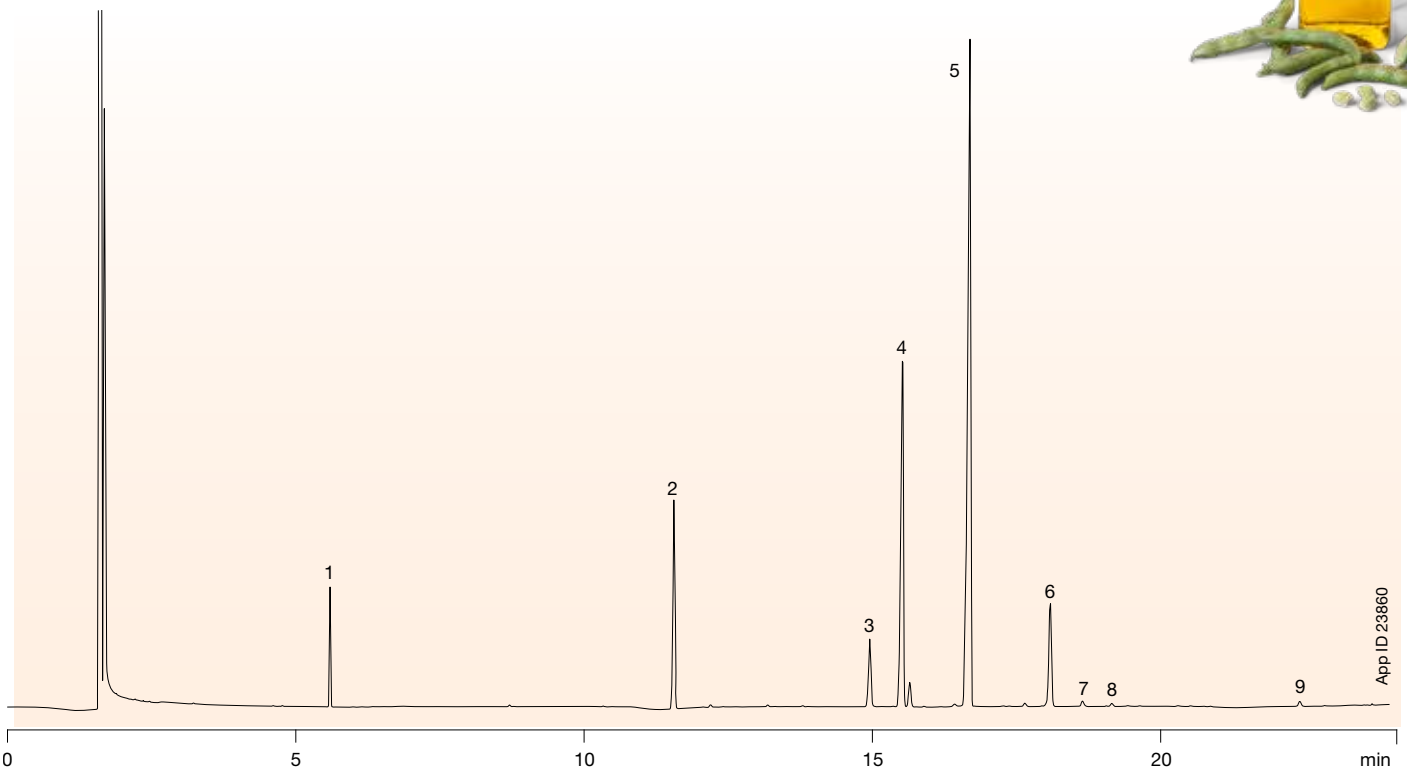
Column: Zebron ZB-FAME
Dimensions: As listed
Injection: Split 50:1 @ 240 °C, 1 µL
Carrier Gas: Helium @ 1.2 mL/min (constant flow)
Oven Program: A) 100 °C for 2 min to 140 °C @ 10 °C/min to 190 °C @ 3 °C/min to 260 °C @ 30 °C/min for 2 min
B) 100 °C for 2 min to 165 °C @ 10 °C/min to 200 °C @ 1.5 °C/min to 280 °C @ 15 °C/min for 1 min
Detector: FID @ 260 °C
Recommended Liner: 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. 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

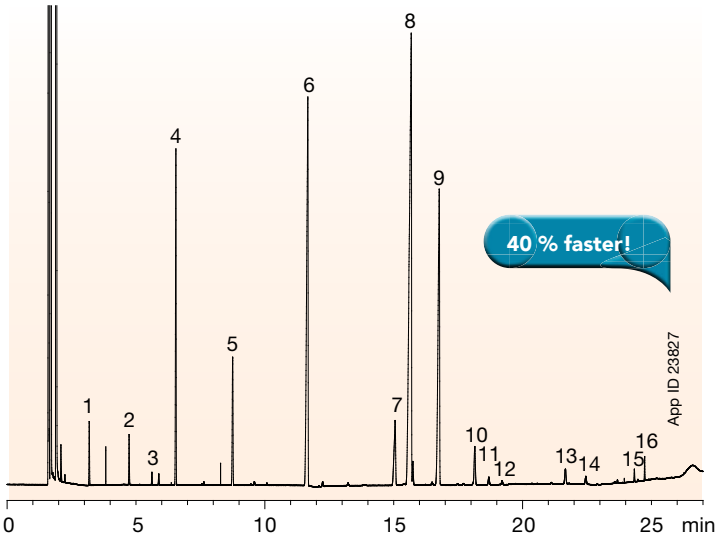
Fatty Acids and FAMES
by GC-FID

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)



Vs.

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 % Na_2CO_3 solution and centrifuge at 5000 rpm for 5 min
5. Extract organic layer for GC analysis

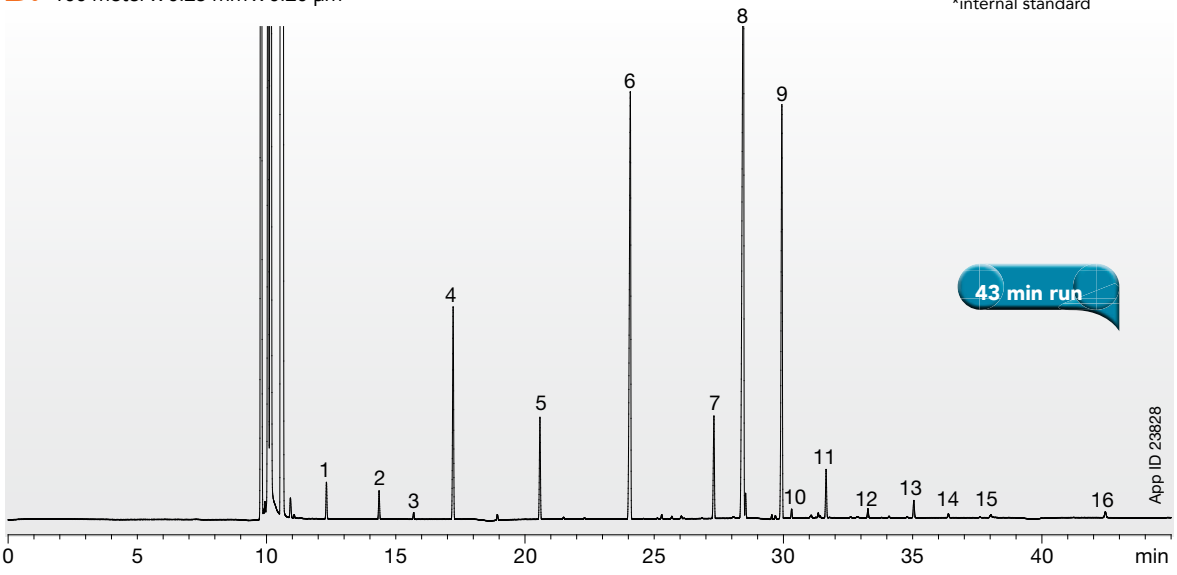
Conditions for both columns:

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

Supelco® SP™-2560

B. 100 meter x 0.25 mm x 0.20 µm

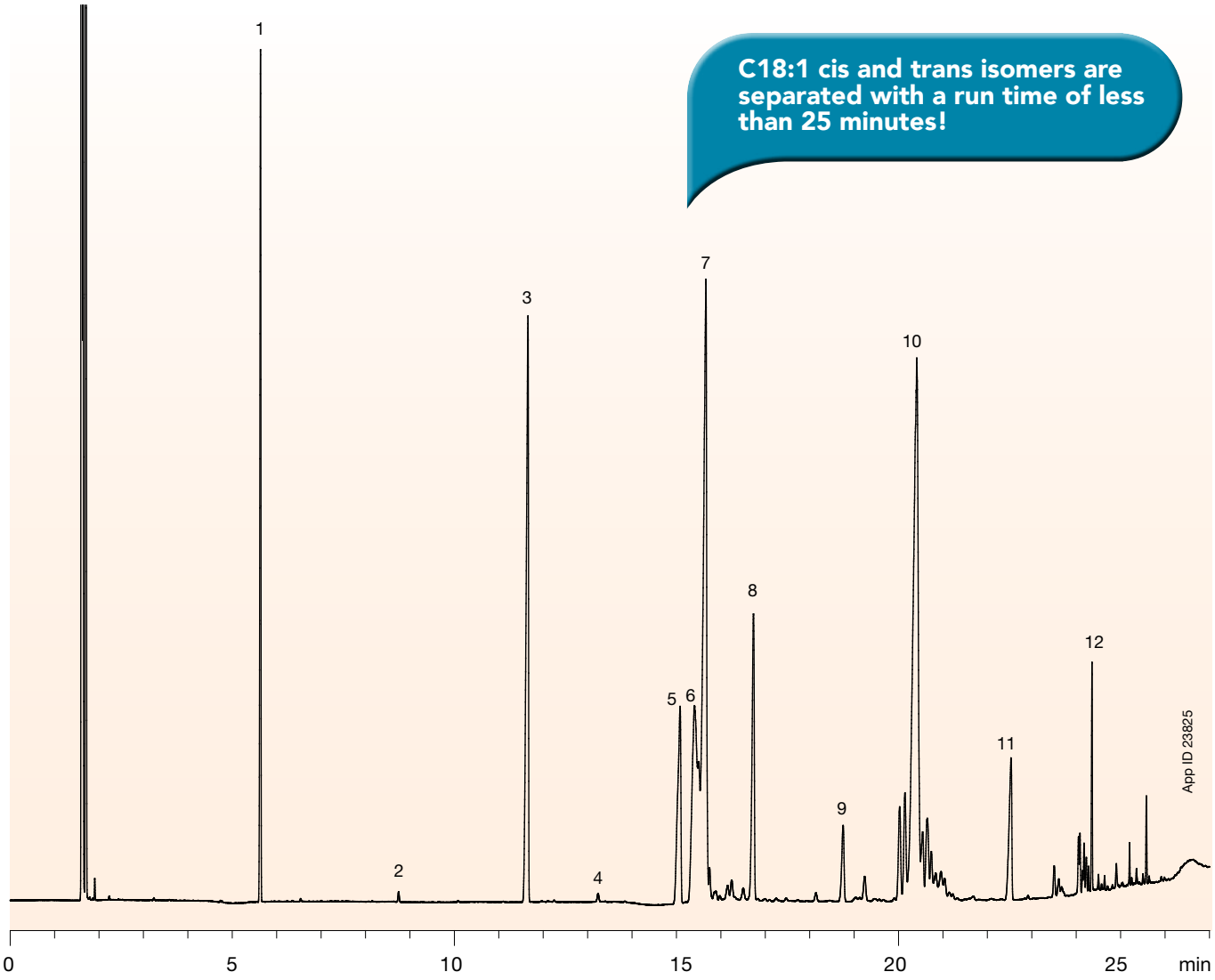


Comparative separations may not be representative of all applications.

Fatty Acids and FAMES
by GC-FID

Peanut Butter

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



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 pyrogallic 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 Na_2SO_4
10. Extract hexane 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:
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

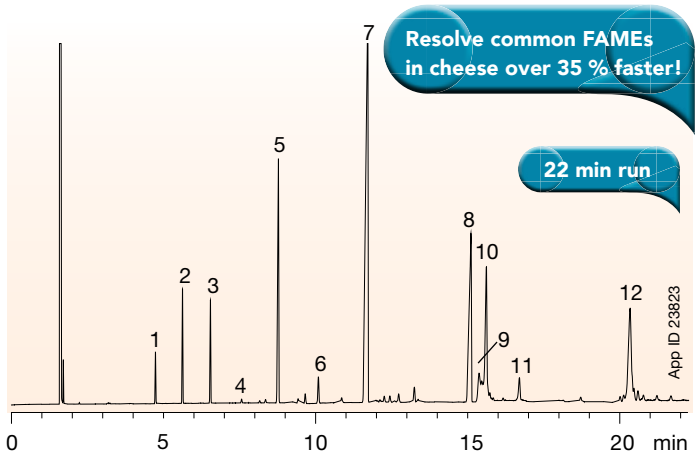
Fatty Acids and FAMES
by GC-FID

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

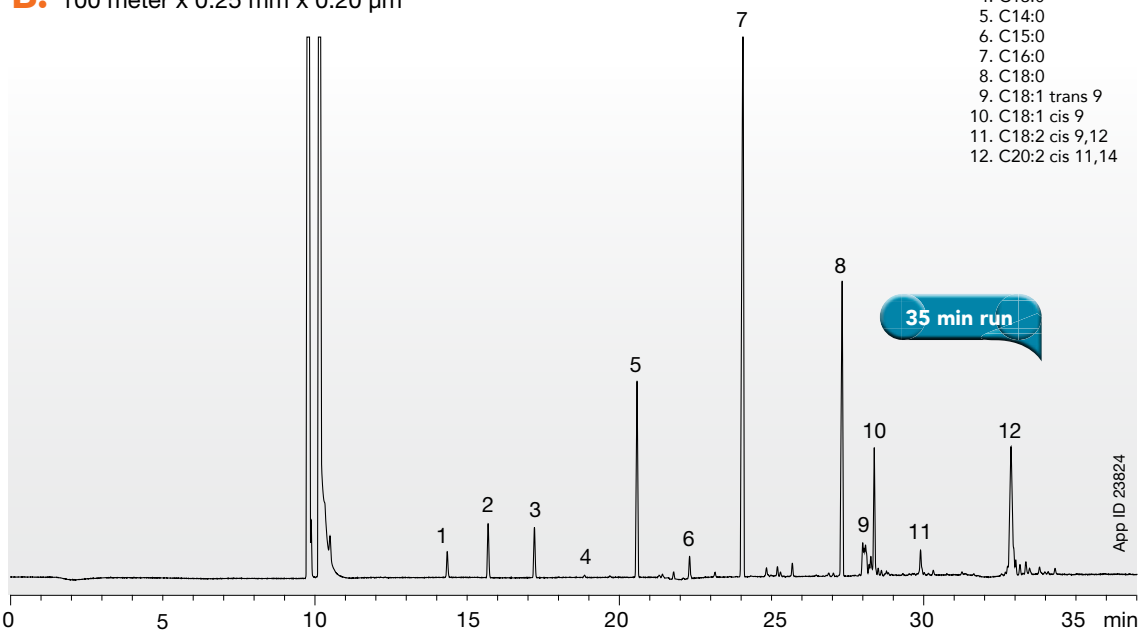
A. 30 meter x 0.25 mm x 0.20 µm (Part No.: 7HG-G033-10)



Vs.

Supelco® SP™-2560

B. 100 meter x 0.25 mm x 0.20 µm



Extraction and Derivatization Protocol:

1. Weigh out 100-200 mg of cheese and place it into a scintillation vial
2. Add 100 mg pyrogallic acid
3. Add 2 mL ethanol followed by 4 mL deionized water and 4 mL NH_4OH (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 Na_2SO_4
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

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:

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

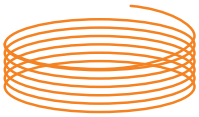
Applications
- High boilers
- GC-MS applications

Advantages
- Faster run times
- Higher temp. limits
- Lower bleed
- Higher efficiency

Disadvantages
- Less inert
- Limited retention

Good Starting Length

30 m



Long
60 m or more

Applications
- Complex samples with closely eluting peaks
- Low boilers
- Less active samples
- Complex temperature ramps

Advantages
- Better resolution

Disadvantages
- 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

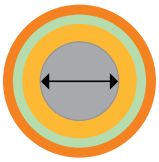
Applications
- Complex samples

Advantages
- Faster run times
- Better resolution

Disadvantages
- Lower sample capacity
- Easily overloaded

Good Starting ID

25 mm



Wide
0.32, or 0.53 mm

Applications
- Dirty samples
- Highly concentrated samples

Advantages
- Increased sample capacity
- Good for on-column injections

Disadvantages
- 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

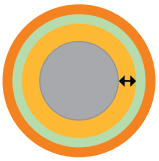
Applications
- High boilers
- GC-MS applications

Advantages
- Faster run times
- Higher temp. limits
- Lower bleed
- Higher efficiency

Disadvantages
- Less inert
- Limited retention

Good Starting Film

25 µm



Thick
50 µm or more

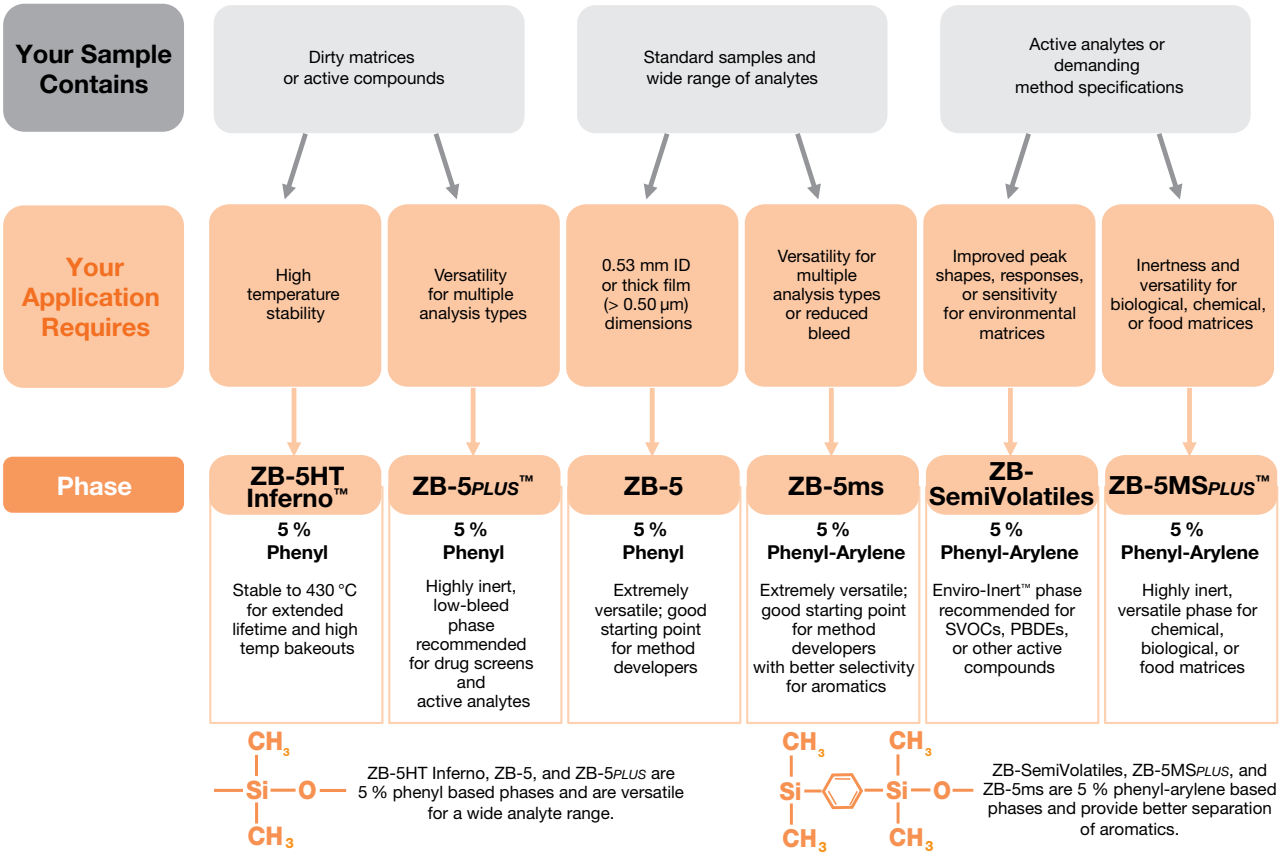
Applications
- Low boilers
- Gases, solvents, purgeables, volatiles
- Purity testing

Advantages
- Better inertness
- Higher capacity

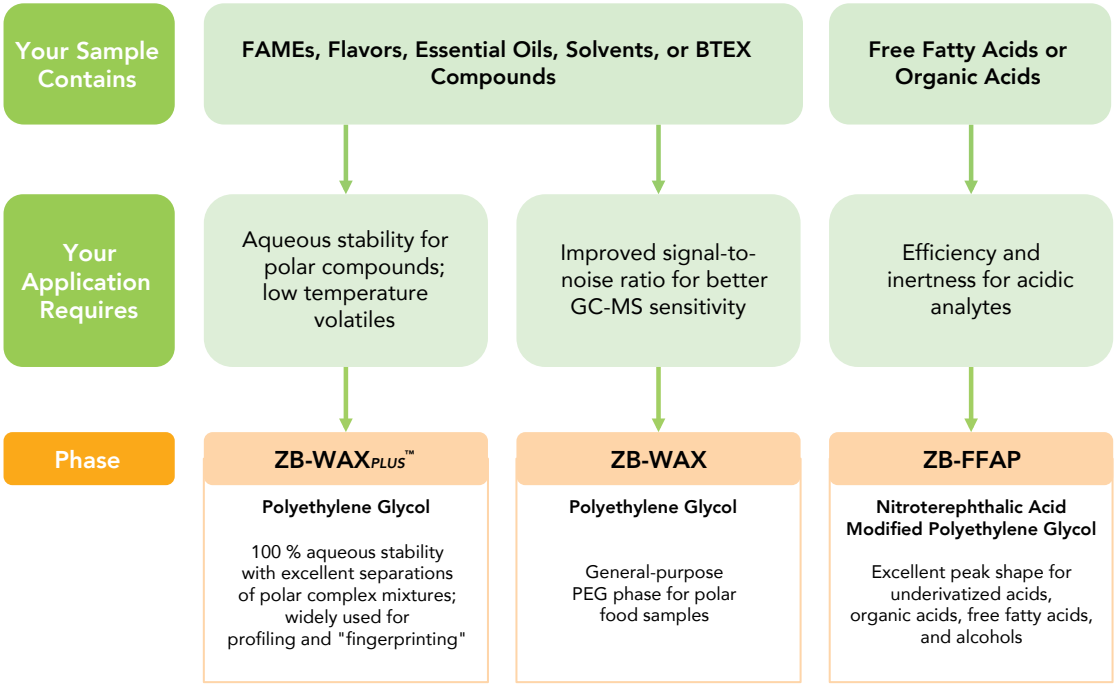
Disadvantages
- Slower run times
- Lower temp. limits
- Higher bleed

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

	Compound Class	Analysis	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
			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	SUPELCOWAX® 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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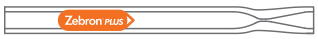
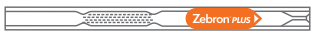
GC Inlet Liner Ordering Information

Zebron™ 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

Zebron™ 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

Zebron 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

Zebron 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

Zebron 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.

Zebron ZB-1*PLUS*™

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.

Zebron ZB-WAX*PLUS*™

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.

Zebron 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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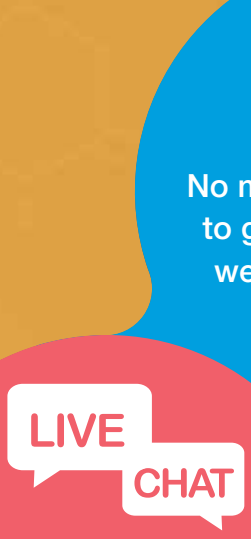

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