2015

Alcoholic Beverage Applications

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General Separation Technologies, Inc.

Alcohol beverages contain wide range of both volatile and non-volatile organic compounds from alcohol, aldehydes, esters, acids and others in presences of water, ethanol and perhaps CO_2. The contents and their concentration levels determine beverage flavor, quality, product shelf life time, and perhaps prices. The level of these contents vary from winery producer, production year, distillation, and environmental/production variations.

GC, GC-MS and GC-Headspace are common analytical tools to measure alcohols, aldehydes, esters and acids, and other organic compounds in beverage samples. As international trade, social consciousness and human life have been changed rapidly now days, there have been some challenges for common beverage quality. These challenges include but not limited to anti-counterfeit, safety of beverage, product shelve lifetime, trade protection and obstacle, prices and competitions. These challenges demand reliable, improved, and accurate GC analysis results.

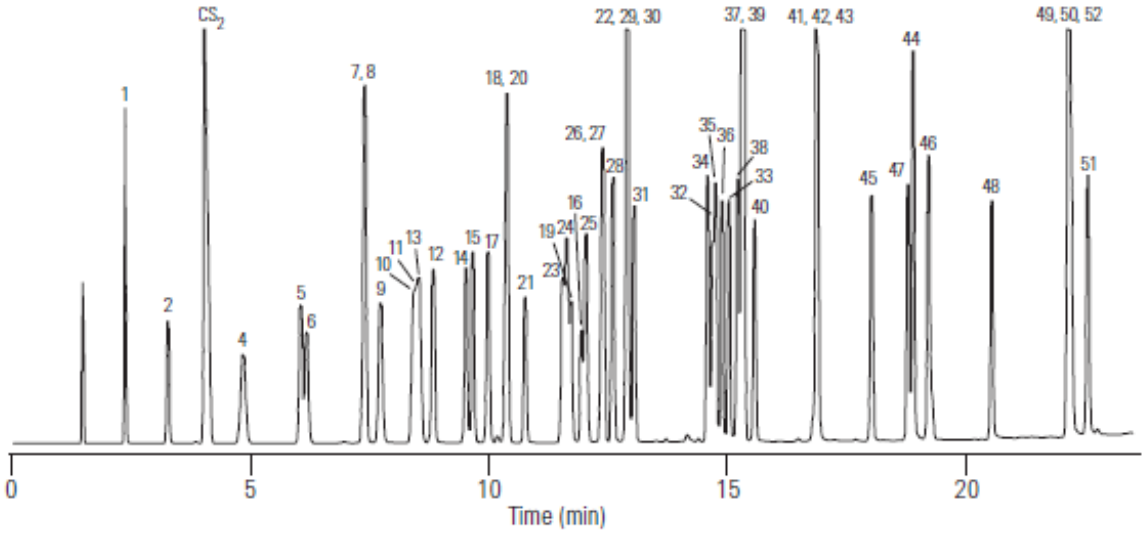
Beverage GC analyses require both good separations and from percentage to ppm level quantitation of interesting compounds. Beverage special liqueur/wine sample contain wide ranges of alcohols, aldehydes, esters, low levels of undesired compounds. Such compound wide range presents a challenge for separation and detection for a raw beverage sample without sample preparations. Because water that is major compound in a beverage may contains many chemicals from environmental pollutions, production contaminations, or transportation accidents, the analysis of waters compliance with many regulations become imminent for beverage industry.

GS-Tek is offering its good GsBP GC columns for many beverage GC analyses. The following chromatograms generated by GS-Tek application chemists and its world-wide customers demonstrate GsBP GC column solution to challenges of beverage GC analyses.

Contents

1. Alcohol separations

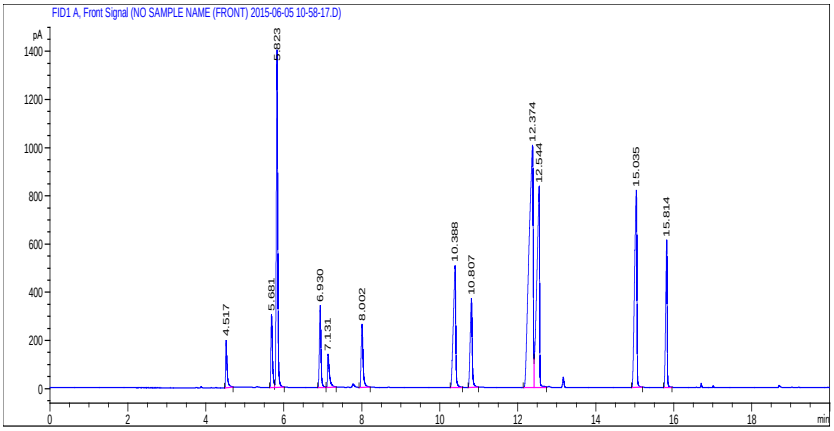
Columns: GsBP-624, 30m x 0.53mm x 3.0um,
Cat No.: 6253-3030 VWR No.: 10499-916
Instrument: GC-FID
Oven: 40C (5min) 10C/min to 250C (10min)
Split: 1:10
Samples: 0.01-0.5% Alcohol in CS_2 solvents



1	Methanol	19	Glycidol	37	Cyclohexanol
2	Ethanol	20	3-Pentanol	38	3-Heptanol
3	Isopropanol	21	2-Ethoxyethanol (Cellosolve)	39	2-Heptanol
4	tert-Butanol	22	Propylene glycol	40	2-Butoxyethanol (butyl
5	2-Propen-1-ol (allyl alcohol)	23	3-Methyl-1-butano (active amyl	41	cis-4-Hepten-1-ol
6	1-Propanol	24	2-Methyl-1-butanol (active amyl	42	trans-2-Hepten-1-ol
7	2-Propyn-1-ol (propargyl	25	4-Methyl-2-pentanol	43	1-Heptanol
8	sec-Butanol	26	1-Pentanol	44	Benzyl alcohol
9	2-Methyl-3-buten-2-ol	27	2-Penten-1-ol	45	2-Ethyl-1-hexanol
10	Isobutanol	28	3-Methy-2-buten-1-ol	46	a-Methylphenyl alcohol
11	2-Methoxyethanol (methyl	29	Cyclopentanol	47	1-Octanol
12	3-Buten-1-ol	30	3-Hexanol	48	1-Nonanol
13	2-Methyl-2-butanol (tert-amyl	31	2-Hexanol	49	2-Phenoxy ethanol
14	1-Butanol	32	4-Hydraxy-4-methyl-2-	50	a-Ethylphenethyl alcohol
15	2-Buten-1-ol (crotyl alcohol)	33	Furfuryl alcohol	51	b-Ethylphenethyl alcohol
16	Ethylene glycol	34	Cis-3-Hexen-1-ol	52	1-Decanol
17	1-Penten-3-ol	35	1-Hexanol		
18	2-Pentanol	36	cis-3-Hexen-1-ol		

2. Alcohol Separation by GsBP-FFAP column

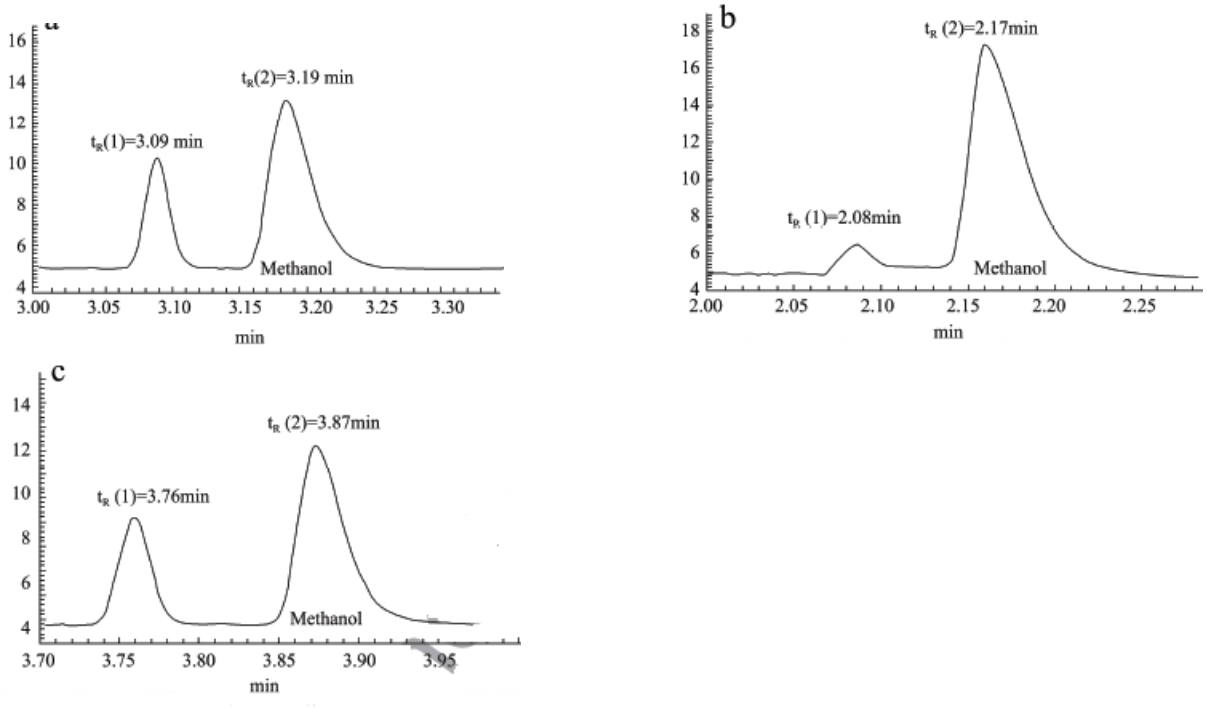
Column: GsBP-FFAP, 50m x 0.20mm x 0.33um
Cat. No.: 2120-5003 VWR No.: 10499-502
Oven: 40C 5min 6C/min 85C 15C/min 150C 1min



1	Acetaldehyde	4.517
2	Acetone	5.681
3	Ethyl formate	5.823
4	Ethyl acetate	6.93
5	Methanol	7.131
6	Ethanol	8.002
7	sec-Butanol	10.388
8	1-Propanol	10.807
9	iso-Butanol	12.374
10	Active amyl alcohol	12.544
11	iso-Amyl alcohol	15.035
12	n-Amyl alcohol	15.814

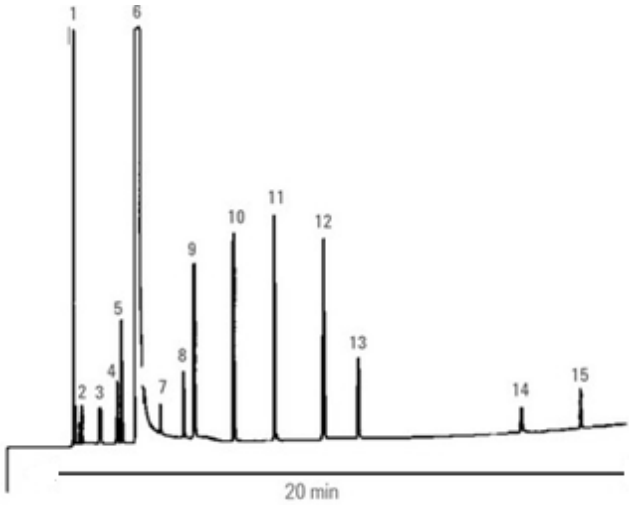
3. Methanol Peak Shape Comparison

(A) ZB-Wax, (B) ZB-624, (C) GsBP-Inowax
Sample: Red wine



4. Beverage standard

Column: GsBP-FFAP, 50m x 0.20mm x 0.33um
Cat. No.: 2120-5003 VWR No.: 10499-502
Oven: 60C (4min) 6C/min to 200C (hold)

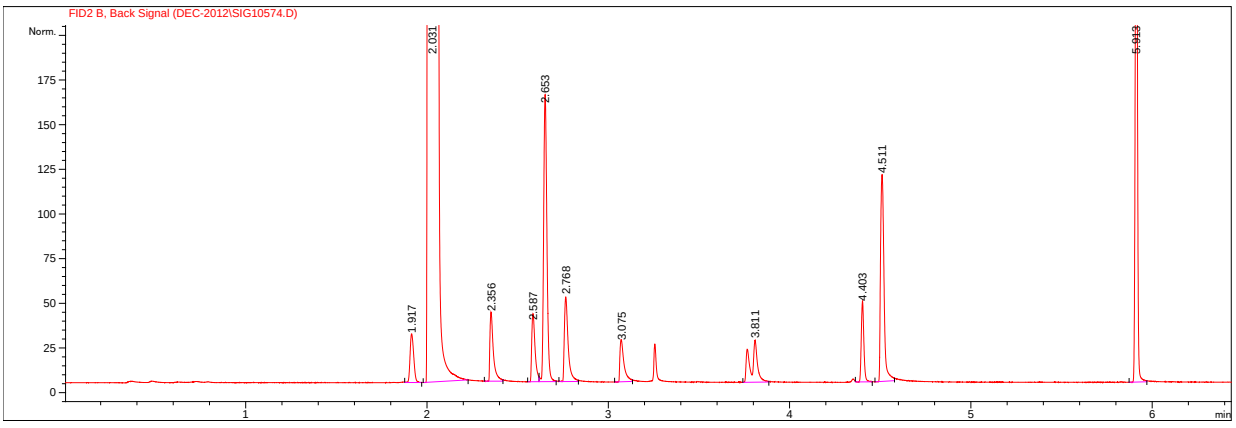


1	Acetone
2	Acetaldehyde
3	Ethyl formate
4	Ethyl acetate Acetal
5	Methanol
6	Ethanol
7	Diacetyl
8	Sec-Butanol
9	n-Propanol
10	Isobutanol
11	n-Butanol
12	Isoamyl alcohol
13	n-Amyl alcohol
14	Acetic acid
15	Propionic acid

5. Wine Standard I

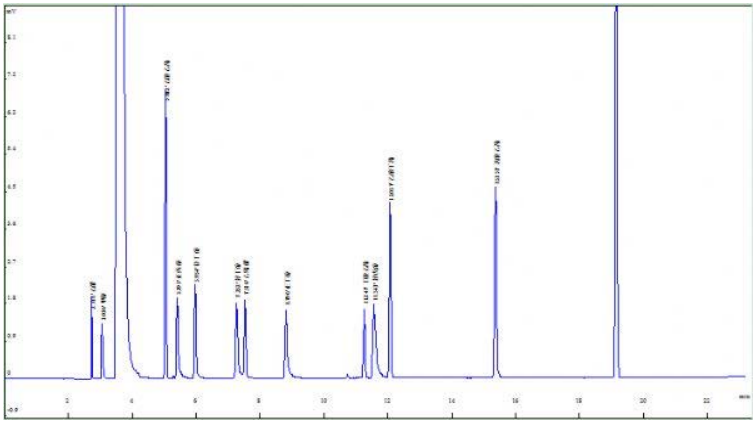
Column: GSBP-1MS, 30m x 0.25mm x 1.0um,
Cat. No.: 1125-3010 VWR No.: 10499-114
Oven: 65C (1min) 20C/min to 220C
Sample: Wine standard

1	Methanol	1.917	7	1-Butanol	3.075
2	Ethanol	2.031	8	3-Pentanol	3.123
3	1-Propanol	2.356	9	Ethyl Butyrate	3.811
4	2-Butanol	2.587	10	n-Butyl Acetate	4.403
5	Ethyl Acetate	2.653	11	Ethyl Lactate	4.511
6	Isobutanol	2.768	12	Ethyl Hexanoate	5.913



6. Wine Standard II

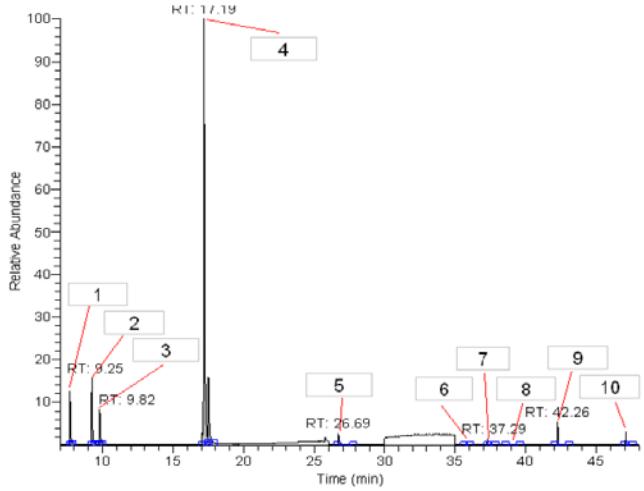
Column: GsbP-1301, 30m x 0.32mm x 1.0um,
Cat. No.: 6032-3010 VWR No.: 10499-792
Oven: 65C (1min) 20C/min to 220C
Sample: wine standard



1	Acetaldehyde	2.718
2	Methanol	3
3	Ethanol	3.668
4	ethyl acetate	5.032
5	1-Propanol	5.391
6	2-Butanol	5.954
7	iso-Butanol	7.252
8	Acetal	7.516
9	1-Butanol	8.796
10	Ethyl Butyrate	11.247
11	3-Pentanol	11.543
12	n-Butyl Acetate	12.057
13	Ethyl Lactate	15.353
14	Ethyl Hexanoate	19.131

7. Distilled whisky

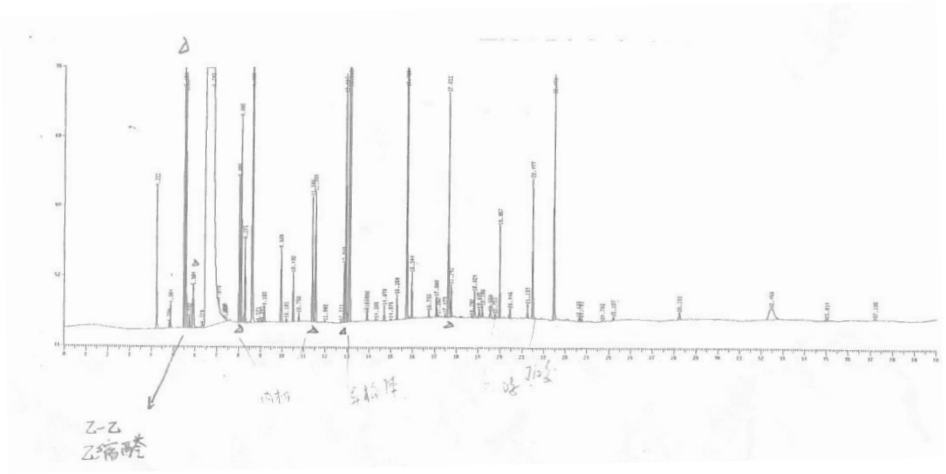
Column: GsBP-5MS, 30m x 0.25mm x 0.25um
Cat. No.: 1525-3002
Instrument: GC-MSD



1 n-Propanol
2 Ethyl acetate
3 iso-Butanol
4 Isoamy alcohol
5 Isoamy acetate
6 2-Phyeny ethanol
7 Ethyl caprylate
8 Ethyl hexanoate
9 Ethyl caprate
10 Ethyl laurate

8. Chinese Mao-tai Liquor

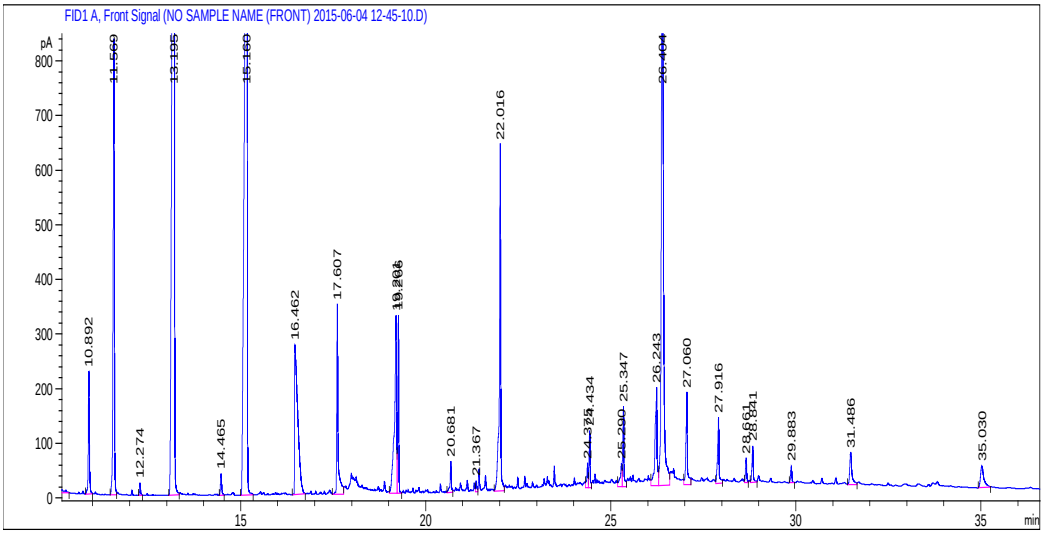
Column: GsBP-Inowax, 50m x 0.25mm x 0.4um
Cat. No.: 2025-5004
Oven: 40C (4min) 5C/min to 240C (hold)



9. Red Wine Extract

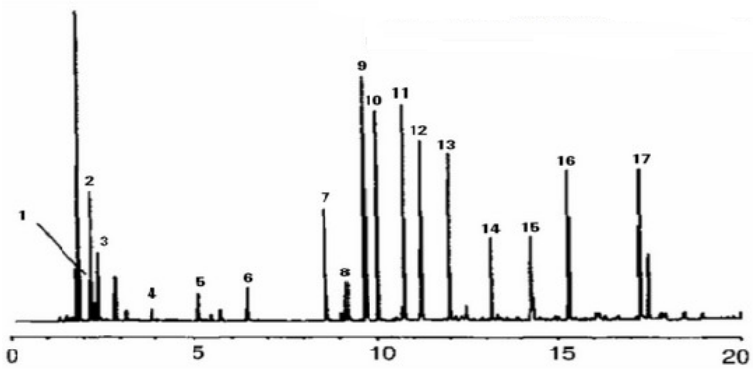
Column: GsBP-FFAP 50m x 0.25mm x 0.3um
Cat. No.: 2125-5003
Oven: 40C 1min 10C/min 260C 10min

Wine flavor is greatly affected by low level sulfurs, acids and aldehydes. GsBP Columns can be used for these analyses.



10. Acids and aldehydes

Column: GsBP-InoWax, 30m x 0.32mm x 0.5um
Cat. No.: 2032-3005
Oven: 60C (1min) 10C/min to 250C Hold

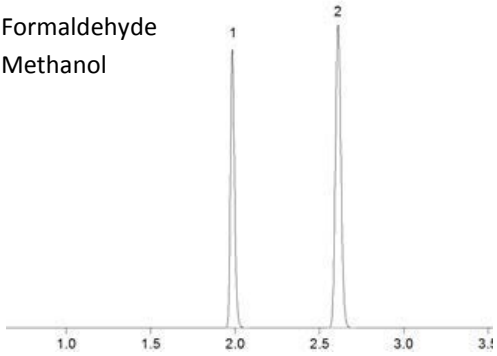


1	Butanal	9	Propanoic acid
2	2-Methyl butanal	10	Iso-Butyric acid
3	Pentanal	11	Butyric acid
4	Hexanal	12	Iso-Valeric acid
5	Heptanal	13	Valeric acid
6	Octanal	14	Hexanoic acid
7	Acetic acid	15	Heptanoic acid
8	Decanal	16	Octanoic acid
		17	Decanoic acid

11. Formaldehyde I

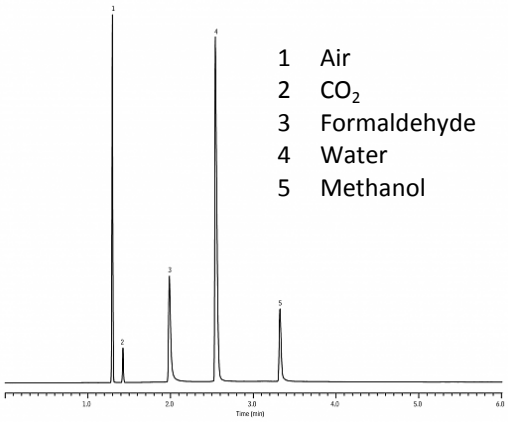
Column: GsBP-1, 30m x 0.32mm x 5um
Cat. No.: 0132-3050
Oven: 50C
Sampling: HS, 60C 10min cycling time, sample, 0.5% in water,

1 Formaldehyde
2 Methanol



12. Formaldehyde II

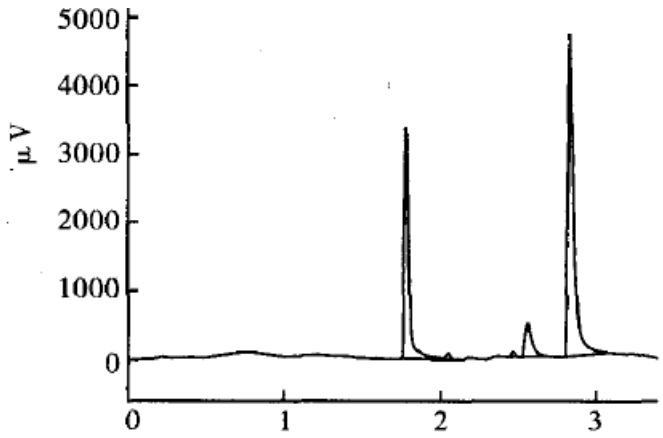
Column: GsBP-PLOT U 30m x 0.53mm x 20um
Cat. No.: 8753-3020
Oven: 100C 31min 25C/min to 150C (3min)
Detector: TCD
Sample: 10ul vapor, 20:1 Split.



1 Air
2 CO_2
3 Formaldehyde
4 Water
5 Methanol

13. Acetaldehyde and Ethanol Separation

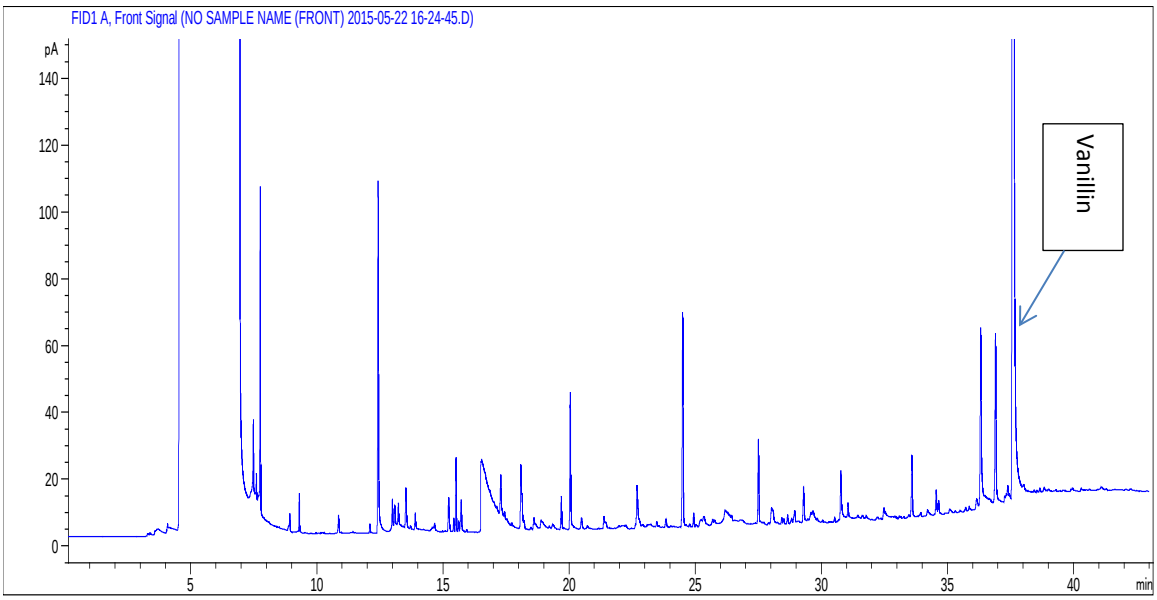
Column: GsBP-Inowax MS, 30m x 0.25mm x 0.25um
Cat. No.: 2425-3002
Oven: 45C
Sample: Flavor extraction of dried jujube



1 Acetaldehyde
2 Methanol
3 Ethanol

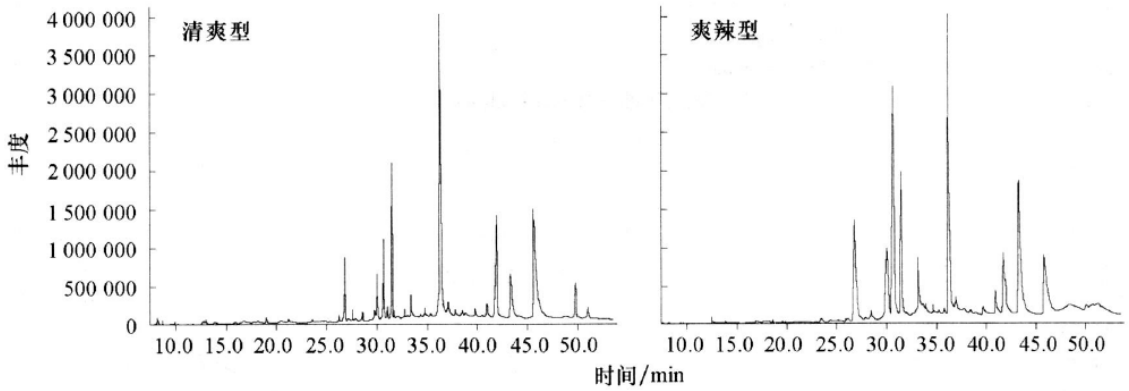
14. Vanillin

Column: GsBP-DHA, 100m x 0.25mm x 0.5um
Cat. No.: 9006-DHA
Oven: 60C 1min 5C/min 250C 10min
Sample: Vanilla from supermarket



15. Flavor of preserved vegetables

Column: GsBP-Inowax, 30m x 0.25mm x 0.25um
Cat. No.: 2025-3002
Oven: 50C (2min), 5C/min to 240C (hold)
Sample: Preserved Vegetables Flavor

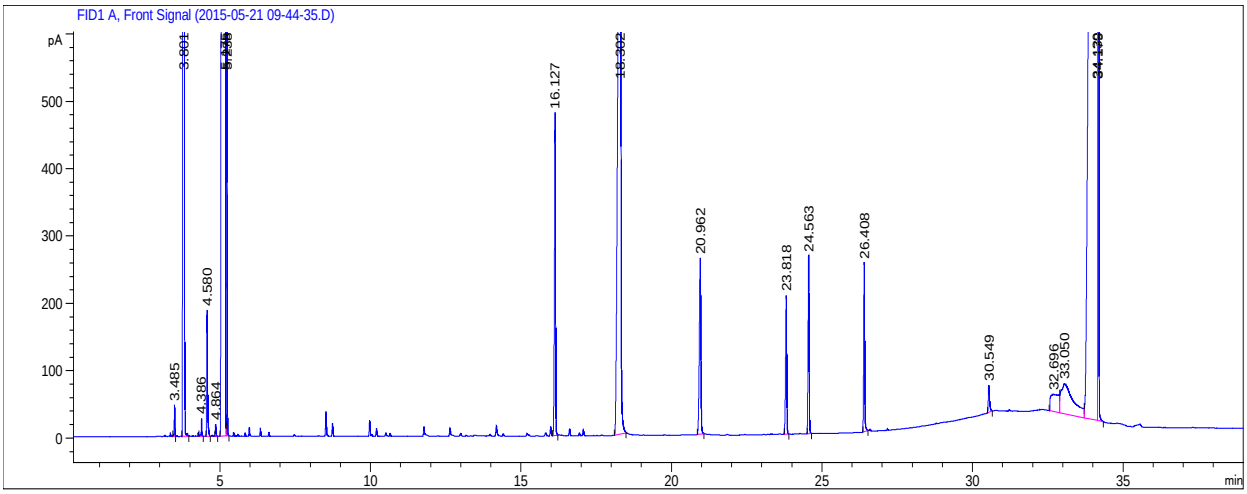


编号	保留时间 /min	化合物	分子式	相对含量 /%	
				爽辣型	清爽型
11	18.20	苯乙烯 (Styrene)	C_8H_8	10.009	10.180
2	8.71	1，3，5-三甲基苯 (Mesitylene)	C_9H_{12}	0.011	0.116
3	9.91	6-甲基-5-庚烯-2-酮 (6-methyl-5-hepten-2-one)	$C_8H_{14}O$	—	0.073
4	19.03	5-乙基噻唑 (5-ethylthiazole)	C_5H_7NS	0.122	0.342
5	27.62	2，4-二叔丁基苯酚 (2，4-Di-tert-butylphenol)	$C_{14}H_{22}O$	—	0.281
6	45.62	(9Z，12Z，15Z)-十八碳三烯醛 (9，12，15-Octadecatrienal)	$C_{18}H_{30}O$	7.958	22.299
7	26.22	苯乙基异硫氰酸盐 (Phenethyl isothiocyanate)	C_9H_9NS	0.053	0.266
		酰胺 (3)		2.023	12.492
8	41.94	棕榈酰胺 (Hexadecanamide)	$C_{16}H_{33}NO$	2.023	7.934
9	49.84	十八酰胺 (Octadecanamide)	$C_{18}H_{37}NO$	—	3.504
10	51.05	9-十八碳烯酰胺 (9-Octadecenamide)	$C_{18}H_{35}NO$	—	1.054
		醇 (3)		0.077	0.123
11	14.45	芳樟醇 (Linalool)	$C_{10}H_{18}O$	0.044	—
12	17.40	松油醇 (α-Terpineol)	$C_{10}H_{18}O$	0.033	—
13	21.23	2-苯乙醇 (Benzeneethanol)	$C_8H_{10}O$	—	0.123
		酯 (9)		47.365	22.377
14	23.58	十四（烷）酸乙酯 (Ethyl myristate)	$C_{16}H_{32}O_2$	0.313	0.201
15	26.52	棕榈酸甲酯 (Methyl palmitate)	$C_{17}H_{34}O_2$	0.242	—
16	26.80	棕榈酸乙酯 (Ethyl palmitate)	$C_{18}H_{36}O_2$	9.920	4.340
17	28.81	(Z，Z)-9，12-十八烷二烯酸甲酯 (Methyl linoleate)	$C_{19}H_{32}O_2$	0.543	0.686
18	29.78	硬酯酸乙酯 (Ethyl stearate)	$C_{20}H_{40}O_2$	—	0.585
19	30.01	油酸乙酯 (Ethyl oleate)	$C_{20}H_{38}O_2$	7.498	3.541
20	30.63	亚油酸乙酯 (Ethyl linoleate)	$C_{20}H_{36}O_2$	19.841	4.588
21	31.03	9，12，15-十八烷三烯酸甲酯 (Methyl9，12，15-octadecatrienoate)	$C_{19}H_{32}O_2$	—	0.482
22	31.52	(Z，Z，Z)-9，12，15-十八烷三烯酸乙酯 (Ethyl linolenate)	$C_{20}H_{34}O_2$	9.008	7.954
		酸 (6)		39.567	38.510
23	33.38	十四（烷）酸 (Myristic acid)	$C_{14}H_{28}O_2$	3.133	1.235
24	34.78	十五烷酸 (Pentadecanoic acid)	$C_{15}H_{30}O_2$	0.228	0.379
25	36.25	棕榈酸 (Palmitic acid)	$C_{16}H_{32}O_2$	17.066	27.926
26	40.94	硬酯酸 (Stearic acid)	$C_{18}H_{36}O_2$	1.314	1.160
27	41.79	油酸 (Oleic acid)	$C_{18}H_{34}O_2$	4.144	1.670
28	43.31	亚油酸 (Linoleic acid)	$C_{18}H_{32}O_2$	13.682	6.140
		检出率		97.185	97.059

注：“—”表示未检出；保留时间按最少时间算。

16. Fragrance Mix I

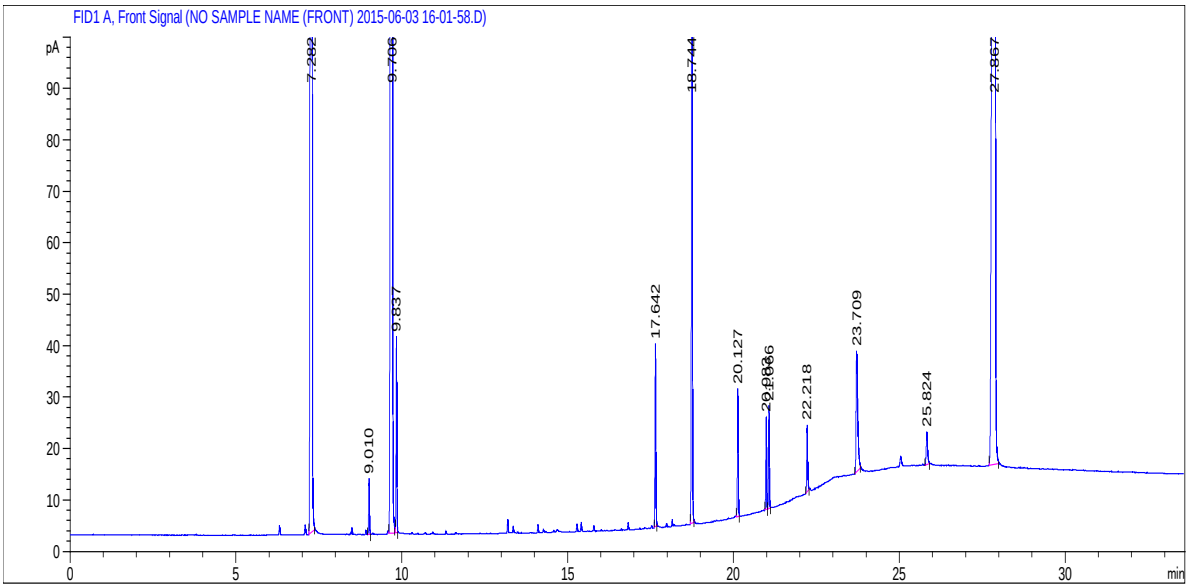
Column: GsBP-DHA, 100m x 0.25mm x 0.5um
Cat. No.: 9006-DHA
Oven: 60C 1min 5C/min 250C 10min
Sample: 12 fragrance mix



1	Ethyl butyrate (105-54-4) 36.2%	3.78
2	d-Limonene (5989-27-5) 20.0%	5.11
3	1,8-Cineole (Eucalyptol) (470-82-6) 0.5%	5.19
4	Geraniol (106-24-1) 0.6%	16.1
5	Hydroxycitronellal (3,7-Dimethyl-7-hydroxyoctanal) (107-75-5) 5.0%	18.14
6	trans Cinnamaldehyde (14371-10-9) 0.5%	20.25
7	Cinnamyl acetate (103-54-8) 0.3%	22.19
8	Thymol (89-83-8) 0.3%	22.75
9	Cinnamyl alcohol (104-54-1) 0.3%	24.59
10	Vanillin (121-33-5) 0.1%	29.66
11	Benzoic acid (65-85-0) 1.0%	32.45
12	Benzyl salicylate (118-58-1) 36.2%	33.34

17. Fragrance Mix II

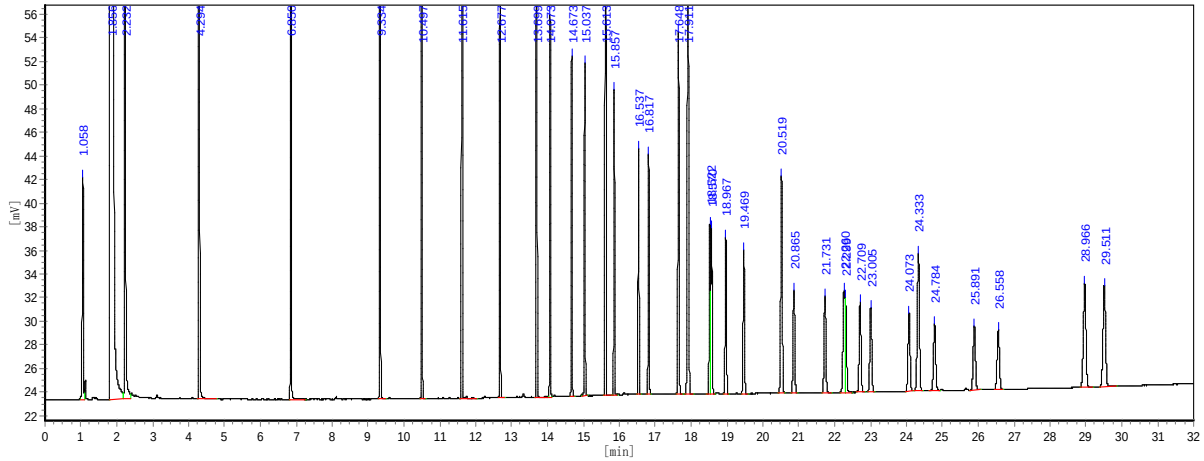
Column: GsBP-FFAP, 50m x 0.25mm x 0.33um
Cat. No.: 2125-5003
Oven: 40C 1min 10C/min 260C 10min



1	Ethyl butyrate	7.282
2	d-Limonene	9.706
3	1,8-Cineole (Eucalyptol)	9.837
4	Geraniol	17.642
5	Hydroxycitronellal	18.744
6	trans Cinnamaldehyde	20.127
7	Cinnamyl acetate	20.983
8	Thymol	21.066
9	Cinnamyl alcohol	22.218
10	Vanillin	23.709
11	Benzoic acid	25.824
12	Benzyl salicylate	27.867

18. FAMEs, 37Mix

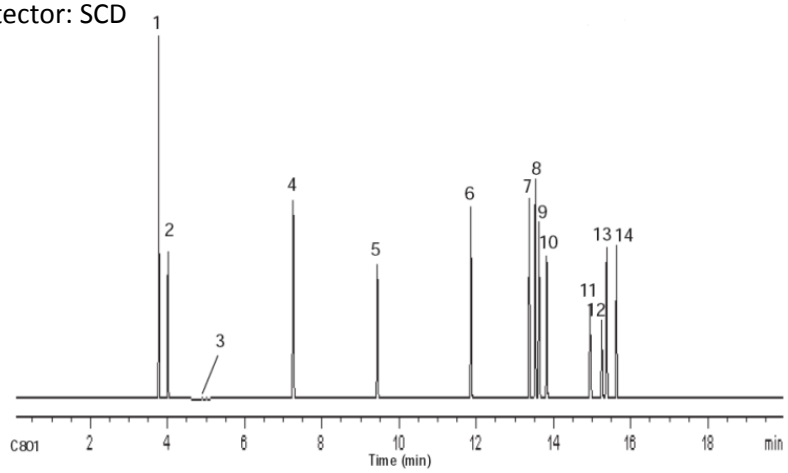
Column: GsBP-FAMEWAX, 30m x 0.32mm x 0.25um
Cat. No.: 6832-3002
Oven: 50C (1min) 10C/min to 200C (1min) 2C/min to 260C (hold)



Compound	Retention Time (min)	Compound	Retention Time (min)	Compound	Retention Time (min)
C4:0	2.232	C17:0	16.537	C20:3(all-cis-11,14,17)	22.26
C6:0	4.294	C17:1(cis-10)	16.817	C20:4(all-cis-5,8,11,14)	23.005
C8:0	6.85	C18:0	17.648	C20:5(all-cis-5,8,11,14,17)	24.073
C10:0	9.334	C18:1(trans-9)	17.911	C21:0	22.299
C11:0	10.497	C18:1(cis-9)	17.911	C22:0	24.333
C12:0	11.615	C18:2(all-trans-9,12)	18.522	C22:1(cis-13)	24.784
C13:0	12.677	C18:2(all-cis-9,12)	18.57	C22:2(all-cis-13,16)	25.891
C14:0	13.699	C18:3(all-cis-6,9,12)	18.967	C22:6 (all-cis-4,7,10,13,16,19)	29.511
C14:1(cis-9)	14.073	C18:3(all-cis-9,12,15)	19.469	C23:0	26.558
C15:0	14.673	C20:0	20.519	C24:0	28.966
C15:1(cis-10)	15.037	C20:1(cis-11)	20.865	C24:1(cis-15)	29.511
C16:0	15.613	C20:2(all-cis-11,14,)	21.731		
C16;1(cis-9)	15.857	C20:3(all-cis-8,11,14)	22.709		

19. Sulfurs I

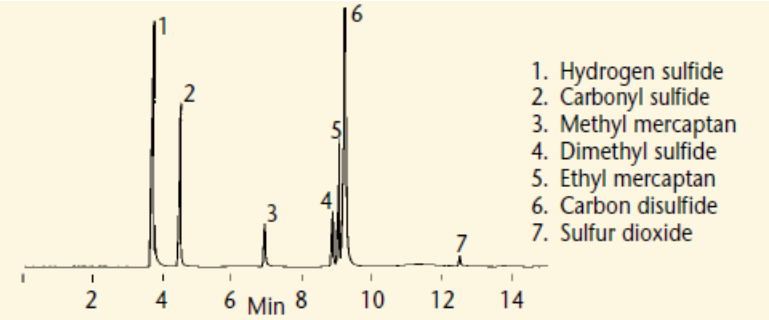
Column: GsBP-GasPro, 30m x 0.32mm x 5um
Cat. No.: 8532-3005
Oven: 50C (2min) 5C/min to 250C (hold)
Detector: SCD



1 COS
2 H_2S
3 Propylene
4 CS_2
5 Methyl mercaptan
6 Ethyl Mercaptan
7 Thiophene
8 Dimethyl sulfide
9 2-Propanethiol
10 1-Propanethiol
11 2-Methyl-2-propanethiol
12 2-Methyl-1-propanethiol
13 1-Methyl-1-propanethiol
14 1-Butanethiol

20. Sulfurs II

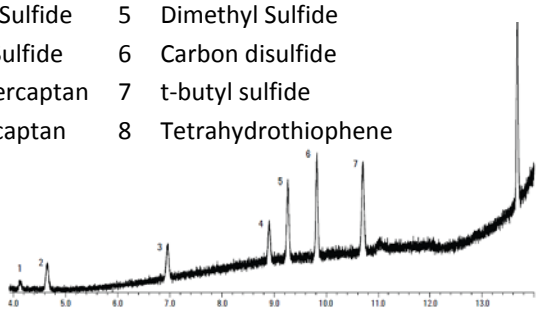
Column: GsBP-PLOT Q, 30m x 0.53mm x 30um
Cat. No.: 8653-3030
Oven: 50C (2min) 10C/min to 250C Hold
Detector: FPD



21. Sulfurs III

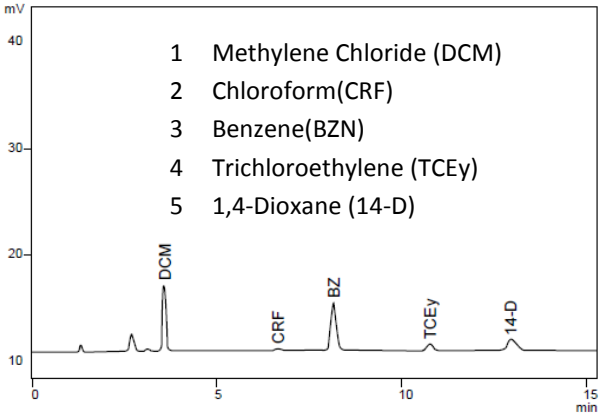
Column: GsBP-1, 60m x 0.32mm x 5um
Cat. No.: 0132-6005
Oven: 40C
Detector: GC-MSD
Residual Solvents by Headspace

1 Hydrogen Sulfide
2 Carbonyl Sulfide
3 Methyl Mercaptan
4 Ethyl Mercaptan
5 Dimethyl Sulfide
6 Carbon disulfide
7 t-butyl sulfide
8 Tetrahydrothiophene



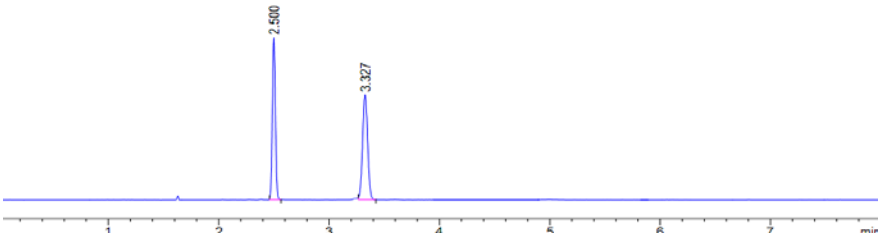
22. Residual Solvents by Headspace

Column: GsBP-624, 30m x 0.53mm x 3.0um
Cat. No.: 6253-3030
Oven temp: 40C
Headspace temp: 100C
Sample: around 20mg/ml in water

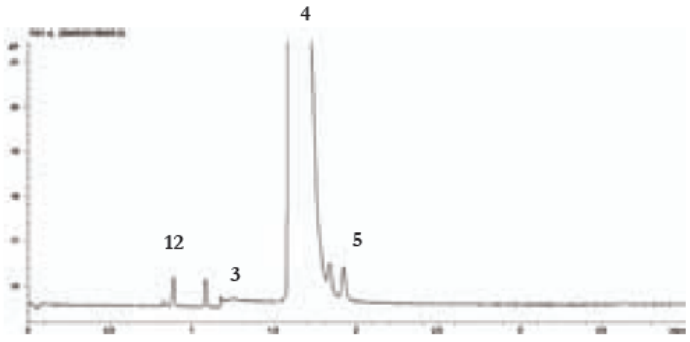


23. Low level Ethylene oxides

Column: GsBP-624, 30m x 0.32mm x 1.8um
Cat. No.: 6232-3018
Oven: 45C
Sampling: Headspace, 70C, needle, 90C, transfer 110C,
Sample: 1. Ethylene oxide (100ug/ml), 2. Methloxirane (50ug/ml) in water



24. Impurities in Ethylene Oxides



Column : GsBP-PLOT U, 30m x 0.32mm x 10um,
Part No : 8732-3010
Oven : 125C
Injection : 180°C, split ratio 30:1
Oven : 150°C(1min) 10C/min to 190C(4min)
Detector : TCD, 200C
Carrier : Hydrogen 1.5ml/min
Sample : 1µL

Peak identification

1. C2
2. C3
3. water
4. ethylene oxide

25. CO2, Alcohol, water and sulfurs

Peak identification

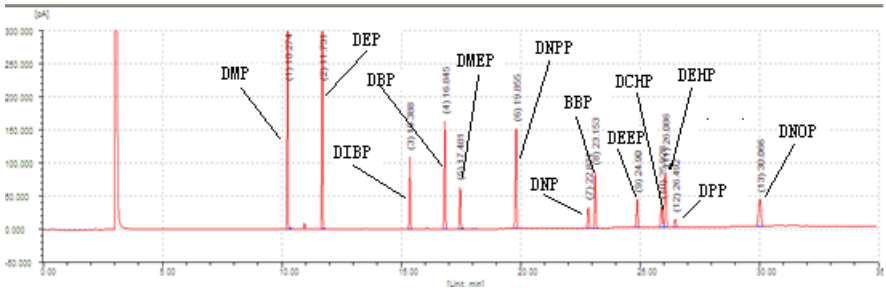
1.Air
2.CH4
3.CO2
4.ethylene
5.ethane
6.H2S
7. COS
8.Water
9.Propylene
10.Propane
11.Methanol
12.i-Butane
13.n-Butane
14.Butene
15.Butene
16.i-pentane
17.n-pentane

Column : GsBP- PLOT "Q",
0.53mm x 30m x 30um
Oven : 60°C (5min)20°C/min to 200°C(1min)
Detector : TCD, 250C
Carrier : Hydrogen,
Inlet : S/S 250C
Sample : 10ul Refinery gas sample

26. Phthalates

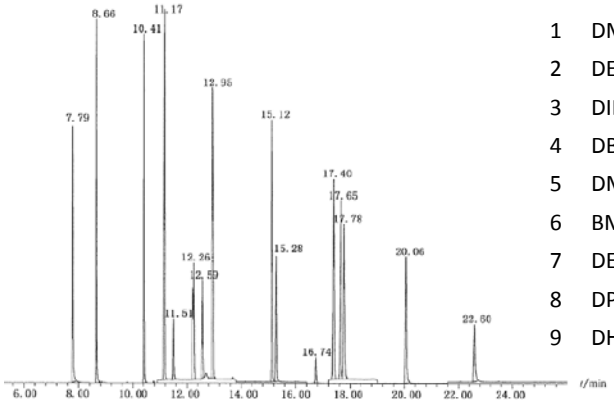
Trace level contaminant analysis becomes very important for both beverage safety and international trade. To detect low level of these contaminants become regulatory requirement by many nations. For example, China government implements very rigorous test methods to detect low level contaminants including phthalates, PCB, Pesticides, PAH, etc. GsBP 5MS columns have been widely used for these applications for water, wine, liqueur, and beverages.

Column: GsBP-5, 30m x 0.32mm x 0.25um
Cat. No.: 0532-3002
Oven: 80C (1min)-
10C/min-260C （ 15min ）



27. 18 Phthalates

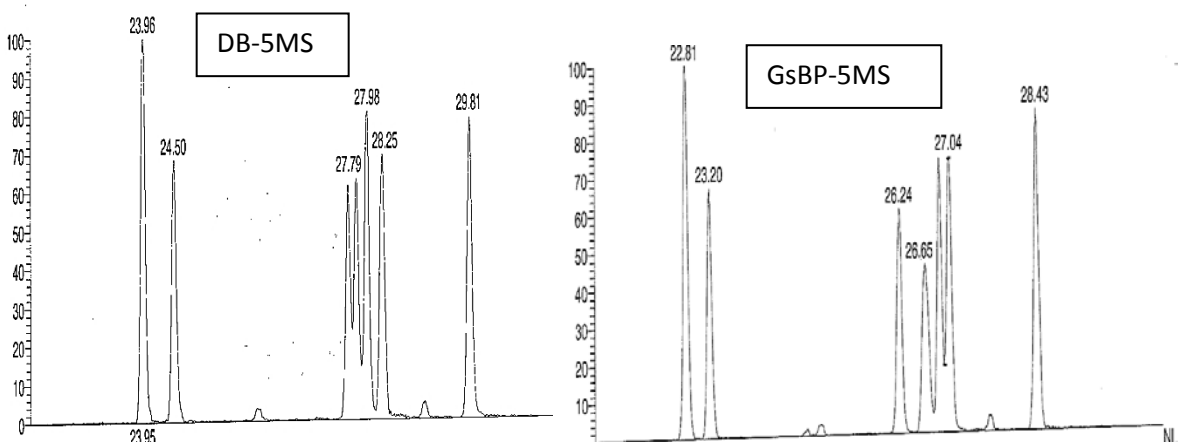
Column: GsbP-5MS, 30m x 0.25mm x 0.25um
Oven: 60C (1min) 20C/min to 220C (1min) 5C/min to 280C (4min)
Sample: 18 Phathalates



1	DMP	10	BBP
2	DEP	11	DBEP
3	DIBP	12	DCHP
4	DBP	13	DEHP
5	DMEP	14	DPP
6	BMPP	15	DNOP
7	DEEP	16	DNP
8	DPP	17	DINP
9	DHXP	18	DIDP

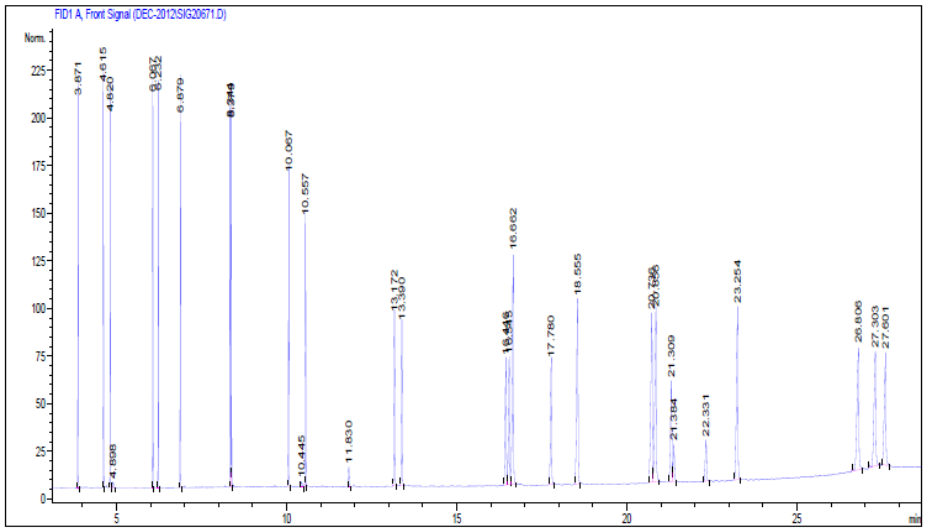
28. Dioxins/PCBs

Column: GsBP-5MS 60m x 0.25mm x 0.25um
Cat. No.: 1525-6002
Oven: 120C, 17C/min to 250C, 2.5C/min to 285C (hold)



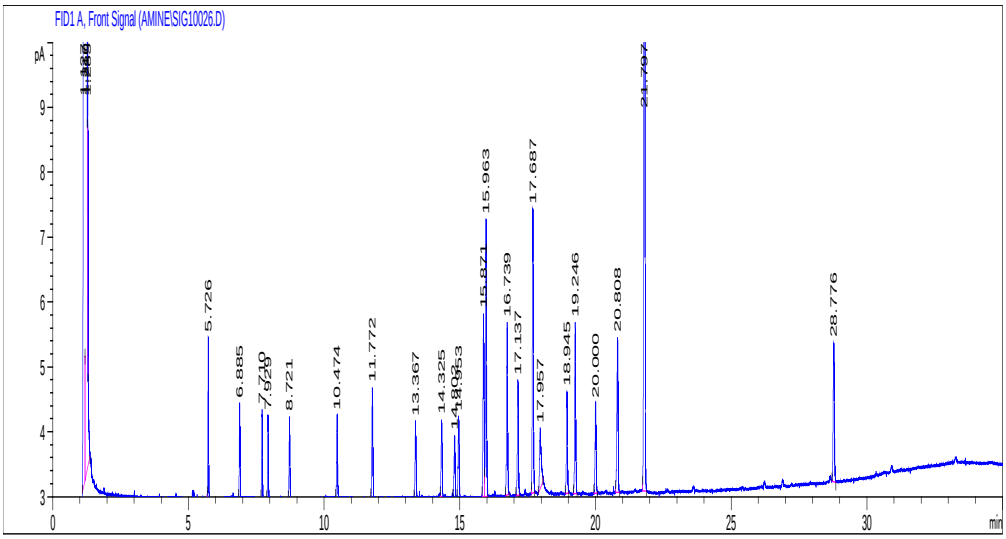
29. 26 PAHs

Column: GsBP-Select PAH, 30m x 0.25mm x 0.2um
Cat. No.: 7325-3002
Oven: 100C (1min) 15C/min to 280C, 5C/min to 340C 10min



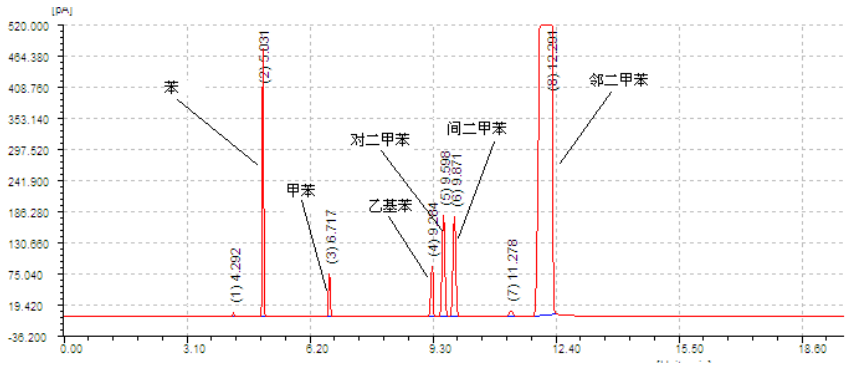
30. Pesticides, 22

Column: GsBP-5MS, 30m x 0.25mm x 0.25um
Cat. No.: 1525-3002
Oven: 150C 4C/min to 275C hold



1	2,4,5,6-Tetrachloro-m-xylene(IS)	12	Dieldrin
2	α-BHC	13	p,p'-DDE
3	β-BHC	14	Endrin
4	γ-BHC	15	Endosulfan II
5	δ-BHC	16	p,p'-DDD
6	Heptachlor	17	Endrin aldehyde
7	Aldrin	18	Endosulfan sulfate
8	Heptachlor epoxide	19	p,p'-DDT
9	γ-Chlordane	20	Endrin ketone
10	Endosulfan I	21	Methoxychlor
11	α-Chlordane	22	Decachlorobiphenyl(IS)

31. BTEXs



32. GS-Tek Recommends the following GC columns for the alcoholic beverage GC analyses

Cat. No.	Description	Analysis note	Instrument Instrumentation Note
0132-6010	GsBP-1, 60m x 0.32mm x 1.0um	Formaldehyde	Large injection
0332-2501	GsBP-Ultra-2, 25m x 0.32mm x 0.17um	Classic Fragrance/flavor Column	
0332-2505	GsBP-Ultra-2, 25m x 0.32mm x 0.52um	Classic Fragrance/flavor Column	
0332-5001	GsBP-Ultra-2, 50m x 0.32mm x 0.17um	Classic Fragrance/flavor Column	
0332-5005	GsBP-Ultra-2, 50m x 0.32mm x 0.52um	Classic Fragrance/flavor Column	
0532-6010	GsBP-5, 60m x 0.32mm x 1.0um	Sulfur/Mecaptans	Large injection
1125-3002	GsBP-1MS, 30m x 0.25mm x 0.25um	Fragrance/flavor	GC-MS
1125-6002	GsBP-1MS, 30m x 0.25mm x 0.25um	Fragrance/flavor	GC-MS
1525-3002UI	GsBP-5MS Inert, 30m x 0.25mm x 0.25um	Pesticides, PAH, PCBs	GC-MS
2018-1001	GsBP-INOWAX, 10m x 0.18mm x 0.18um	Fragrance/flavor, aromatics	GC-MS, fast separation
2018-2001	GsBP-INOWAX, 20m x 0.18mm x 0.18um	Fragrance/flavor, aromatics	GC-MS, fast separation
2018-2003	GsBP-INOWAX, 20m x 0.18mm x 0.36m	Fragrance/flavor, aromatics	GC-MS, fast separation
2018-4001	GsBP-INOWAX, 40m x 0.18mm x 0.18um	Fragrance/flavor, aromatics	GC-MS, fast separation
2018-4003	GsBP-INOWAX, 40m x 0.18mm x 0.36um	Fragrance/flavor, aromatics	GC-MS, fast separation
2120-5003	GsBP-FFAP, 50m x 0.20mm x 0.30um	Classic choice of beverage column	
2125-1502	GsBP-FFAP, 15m x 0.25mm x 0.25um	Great Acid/ester peak shape	
2125-3002	GsBP-FFAP, 30m x 0.25mm x 0.25um	Great Acid/ester peak shape	
2125-3005	GsBP-FFAP, 30m x 0.25mm x 0.50um	Great Acid/ester peak shape	
2125-6002	GsBP-FFAP, 60m x 0.25mm x 0.25um	Great Acid/ester peak shape	
2125-6005	GsBP-FFAP, 60m x 0.25mm x 0.50um	Great Acid/ester peak shape	
2132-1502	GsBP-FFAP, 15m x 0.32mm x 0.25um	Great Acid/ester peak shape	
2132-3002	GsBP-FFAP, 30m x 0.32mm x 0.25um	Great Acid/ester peak shape	
2132-3005	GsBP-FFAP, 30m x 0.32mm x 0.50um	Great Acid/ester peak shape	
2132-3010	GsBP-FFAP, 30m x 0.32mm x 1.0um	Great Acid/ester peak shape	
2132-5005	GsBP-FFAP, 50m x 0.32mm x 0.50um	Classic choice of beverage column	
2132-6005	GsBP-FFAP, 60m x 0.32mm x 0.50um	Great Acid/ester peak shape with improved resolutions	
2132-6010	GsBP-FFAP, 60m x 0.32mm x 1.0um	Great Acid/ester peak shape	
2153-1010	GsBP-FFAP, 10m x 0.53mm x 1.00um	Great Acid/ester peak shape	Fast
2153-1505	GsBP-FFAP, 15m x 0.53mm x 0.50um	Great Acid/ester peak shape	Fast
2153-1510	GsBP-FFAP, 15m x 0.53mm x 1.00um	Great Acid/ester peak shape	Fast
2153-3002	GsBP-FFAP, 30m x 0.53mm x 0.25um	Great Acid/ester peak shape	Large injection
2153-3005	GsBP-FFAP, 30m x 0.53mm x 0.50um	Great Acid/ester peak shape	Large injection
2153-3010	GsBP-FFAP, 30m x 0.53mm x 1.00um	Great Acid/ester peak shape	Head Space, large injection
2153-3015	GsBP-FFAP, 30m x 0.53mm x 1.50um	Great Acid/ester peak shape	Head Space, large injection

2153-6010	GsBP-FFAP, 60m x 0.53mm x 1.00um	Great Acid/ester peak shape	Head Space, large injection
2220-2501	GsBP-CarboWax 20M, 25m x 0.20mm x 0.10um	Better general separations than Innowax column, alcohol co-elution limitation	
2220-5001	GsBP-CarboWax 20M, 50m x 0.20mm x 0.10um	Better general separations than Innowax column, alcohol co-elution limitation	
2225-1502	GsBP-CarboWax 20M, 15m x 0.25mm x 0.25um	Better general separations than Innowax column, alcohol co-elution limitation	
2225-3002	GsBP-CarboWax 20M, 30m x 0.25mm x 0.25um	Better general separations than Innowax column, alcohol co-elution limitation	
2225-3005	GsBP-CarboWax 20M, 30m x 0.25mm x 0.50um	Better general separations than Innowax column, alcohol co-elution limitation	
2225-6002	GsBP-CarboWax 20M, 60m x 0.25mm x 0.25um	Better general separations than Innowax column, alcohol co-elution limitation	
2232-2503	GsBP-CarboWax 20M, 25m x 0.32mm x 0.30um	Better general separations than Innowax column, alcohol co-elution limitation	
2232-3002	GsBP-CarboWax 20M, 30m x 0.32mm x 0.25um	Better general separations than Innowax column, alcohol co-elution limitation	
2232-3003	GsBP-CarboWax 20M, 30m x 0.32mm x 0.3um	Better general separations than Innowax column, alcohol co-elution limitation	
2232-3005	GsBP-CarboWax 20M, 30m x 0.32mm x 0.5um	Better general separations than Innowax column, alcohol co-elution limitation	
2232-5003	GsBP-CarboWax 20M, 50m x 0.32mm x 0.30um	Better general separations than Innowax column, alcohol co-elution limitation	
2232-6002	GsBP-CarboWax 20M, 60m x 0.32mm x 0.25um	Better general separations than Innowax column, alcohol co-elution limitation	
2253-1013	GsBP-CarboWax 20M, 10m x 0.53mm x 1.33um	Better general separations than Innowax column, alcohol co-elution limitation	Fast
2253-3010	GsBP-CarboWax 20M, 30m x 0.53mm x 1.0um	Better general separations than Innowax column, alcohol co-elution limitation	
2253-3013	GsBP-CarboWax 20M, 30m x 0.53mm x 1.33um	Better general separations than Innowax column, alcohol co-elution limitation	
2253-6013	GsBP-CarboWax 20M, 60m x 0.53mm x 1.33um	Better general separations than Innowax column, alcohol co-elution limitation	
2425-3002	GsBP-Inowax-MS, 30m x 0.25mm x 0.25um	Fragrance/flavor, aromatics	GC-MS
2425-6002	GsBP-Inowax-MS, 60m x 0.25mm x 0.25um	Fragrance/flavor, aromatics	GC-MS
2425-6005	GsBP-Inowax-MS, 60m x 0.25mm x 0.50um	Fragrance/flavor, aromatics	
2432-3002	GsBP-Inowax-MS, 30m x 0.32mm x 0.25um	Fragrance/flavor, aromatics	
2432-3005	GsBP-Inowax-MS, 30m x 0.32mm x 0.50um	Fragrance/flavor, aromatics	
6025-3002	GsBP-1301, 30m x 0.25mm x 0.25um	Better Alcohol/ester separations	
6025-3002MS	GsBP-1301MS, 30m x 0.25mm x 0.25um	Better Alcohol/ester separations	
6025-3010	GsBP-1301, 30m x 0.25mm x 1.00um	Better Alcohol/ester separations	
6025-6002	GsBP-1301, 60m x 0.25mm x 0.25um	Better Alcohol/ester separations	
6025-6010	GsBP-1301, 60m x 0.25mm x 1.00um	Better Alcohol/ester separations	
6032-1502	GsBP-1301, 15m x 0.32mm x 0.25um	Better Alcohol/ester separations	
6032-1510	GsBP-1301, 15m x 0.32mm x 1.00um	Better Alcohol/ester separations	
6032-3002	GsBP-1301, 30m x 0.32mm x 0.25um	Better Alcohol/ester separations	
6032-3010	GsBP-1301, 30m x 0.32mm x 1.00um	Better Alcohol/ester separations	
6032-6002	GsBP-1301, 60m x 0.32mm x 0.25um	Better Alcohol/ester separations	
6032-6010	GsBP-1301, 60m x 0.32mm x 1.00um	Better Alcohol/ester separations	
6053-1510	GsBP-1301, 15m x 0.53mm x 1.00um	Better Alcohol/ester separations	Fast
6053-3010	GsBP-1301, 30m x 0.53mm x 1.00um	Better Alcohol/ester separations	Large injection

6053-3015	GsBP-1301, 30m x 0.53mm x 1.50um	Better Alcohol/ester separations	Large injection
6232-3018	GsBP-624, 30m x 0.32mm x 1.80um	Better Alcohol/ester separations	Large injection
6253-3030	GsBP-624, 30m x 0.53mm x 3.00um	Better Alcohol/ester separations	Large injection
7232-3012ALC2	GsBP-ALC2 30m x 0.32mm x 1.20um	Confirmation of alcohol separations	
7253-3020ALC2	GsBP-ALC2 30m x 0.53mm x 2.0um	Confirmation of alcohol separations	Large injection
8625-3008	GsBP-PLOT Q, 30m x 0.25mm x 8um	Great Volatile alcohol/ketone/ester separations	
8632-1515	GsBP-PLOT Q, 15m x 0.32mm x 15.0um	Great Volatile alcohol/ketone/ester separations	
8632-3015	GsBP-PLOT Q, 30m x 0.32mm x 15.0um	Great Volatile alcohol/ketone/ester separations	
8632-5005	GsBP-PLOT Q, 50m x 0.32mm x 5um	Great Volatile alcohol/ketone/ester separations	
8653-1030	GsBP-PLOT Q, 10m x 0.53mm x 30.0um	Great Volatile alcohol/ketone/ester separations	Fast
8653-1530	GsBP-PLOT Q, 15m x 0.53mm x 30.0um	Great Volatile alcohol/ketone/ester separations	Fast
8653-2530	GsBP-PLOT Q, 25m x 0.53mm x 30.0um	Great Volatile alcohol/ketone/ester separations	Head Space
8653-3030	GsBP-PLOT Q, 30m x 0.53mm x 30.0um	Great Volatile alcohol/ketone/ester separations	Head Space
8653-5010	GsBP-PLOT Q, 50m x 0.53mm x 10.0um	Great Volatile alcohol/ketone/ester separations	Head Space
8725-3005	GsBP-PLOT U, 30m x 0.25mm x 5um	Improved Alcohol peaks	
8732-1510	GsBP-PLOT U, 15m x 0.32mm x 10.0um	Improved Alcohol peaks	
8732-3010	GsBP-PLOT U, 30m x 0.32mm x 10.0um	Improved Alcohol peaks	
8732-3020	GsBP-PLOT U, 30m x 0.32mm x 20.0um	Improved Alcohol peaks	
8753-1520	GsBP-PLOT U, 15m x 0.53mm x 20.0um	Improved Alcohol peaks	Fast
8753-3020	GsBP-PLOT U, 30m x 0.53mm x 20.0um	Improved Alcohol peaks, formaldehyde	Head Space
8832-0710	GsBP-Blood Alcohol, 7m x 0.32mm x 10.0um	Quick Screen of volatile alcohol/ketone/aldehyde	
9002-PONA	GsBP-PONA 50m x 0.20mm x 0.5um	Versatile separations for research	GS-MS
9006-DHA	GsBP-DHA, 100m x 0.25mm x 0.5um +2m	Versatile separations for research	GC-MS