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Application News

No. G304A

Gas Chromatography

Analysis of Volatile Sulfur Compounds in Beer Using Nexis™ SCD-2030

Fig. 1 Nexis™ SCD-2030 + HS-20

Volatile sulfur compounds in beer can be generated during production and storage. These sulfur compounds give beer their distinct aroma and flavor characteristics and can have a significant impact on product quality.

However, even trace-level concentrations of sulfur compounds can affect the flavor characteristics and quality of beer. Analysis of sulfur compounds with high sensitivity is required for accurate quality control and product development.

We analyzed volatile sulfur compounds in three commercially available beer samples using gas chromatography (GC) with headspace (HS-20) and sulfur chemiluminescence detection (SCD).

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Reagent Preparation

Three different brands of beer were prepared for this evaluation. Each 5 g beer sample was poured into a 20 mL headspace vial, and 5 µL of 0.1 mL/L of ethyl methyl sulfide aqueous solution was added to the sample as an internal standard at 100 pL/g (ppb).

These vials were placed in the HS-20 headspace sampler and analyzed by an automated GC sequence.

In addition to quantifying sulfur compounds in the beer samples, we used a standard addition by spiking 5 µL of dimethyl sulfide, S-methyl thioacetate and dimethyl disulfide aqueous solution to each sample. Sample concentrations are equivalent to the values shown in Table 1.

Table 1 Concentrations of Sulfur Compounds in Each Beer Sample (pL/g)

Compounds	①	②	③	④
Dimethyl Sulfide	0	100	50	10
S-Methyl Thioacetate	0	10	5	1
Dimethyl Disulfide	0	10	5	1
Ethyl Methyl Sulfide (IS)	100	100	100	100

Analytical Conditions

Table 2 shows the details of instrument configuration and analytical conditions in this evaluation.

Table 2 Instrument Configuration and Analytical Conditions

Model	: Nexis GC-2030 / SCD-2030 / HS-20
HS-20	
Mode	: Loop
Oven Temperature	: 45 °C
Sample Line Temperature	: 95 °C
Transfer Line Temperature	: 95 °C
Vial Pressure	: 150 kPa
Vial Heat-retention Time	: 40 min
Vial Pressurization Time	: 1 min
Vial Pressurization Equilibrating Time	: 0.1 min
Loading Time	: 1 min
Loading Pressurization Time	: 0.1 min
Injection Time	: 1 min
Needle Flush Time	: 5 min
GC-2030	
Injection Mode	: Split
Split Ratio	: 1:5
Carrier Gas	: He
Carrier Gas Control	: Constant Linear Velocity (45 cm/sec)
Column	: SH-I-1MS (30 m × 0.32 mm I.D. df=4.00 µm) *1
Column Temp	: 35 °C (5 min) - 5 °C/min - 100 °C - 10 °C/min - 230 °C (5 min)
SCD-2030	
Interface Temp	: 200 °C
Electric Furnace Temp	: 850 °C
Detector Gas	: H_2 80.0 mL/min N_2 40.0 mL/min O_2 10.0 mL/min O_3 25.0 mL/min

*1 P/N: 227-36011-01

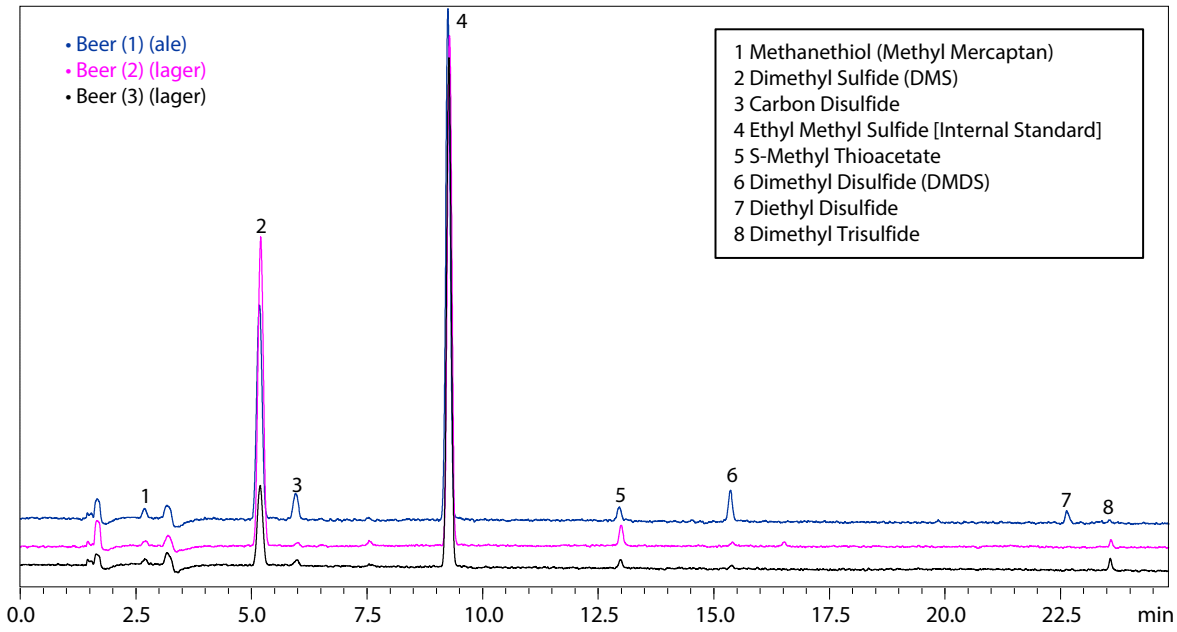

Fig. 2 Chromatogram of Three Commercially Available Beers

Results

Fig. 2 shows the chromatograms of three beer samples. Seven types of sulfur compounds were detected in these samples.

Dimethyl sulfide (Peak No. 2), S-methyl thioacetate (Peak No. 5), and dimethyl disulfide (Peak No. 6) were quantitated using standard addition. Table 3 shows the quantitative results of these three representative sulfur compounds in each beer sample.

Fig. 3 shows an enlarged chromatogram of dimethyl sulfide with different amounts of standard added in beer matrices. These results exhibit the high sensitivity of the detector even at low ppb levels.

Fig. 4 shows the calibration curve for dimethyl sulfide.

Table 3 Quantitative Results of Sulfur Compounds in Each Beer Sample (pL/g)

	Beer 1	Beer 2	Beer 3
Dimethyl Sulfide	66.0	96.0	18.6
S-Methyl Thioacetate	7.23	11.6	3.97
Dimethyl Disulfide	1.93	0.106	0.054

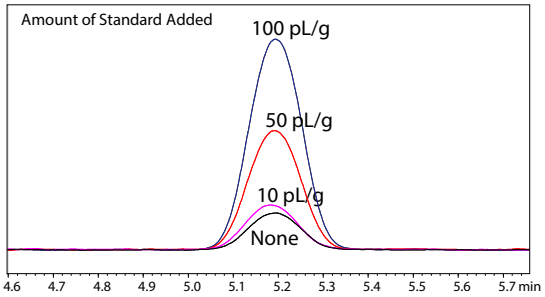

Fig. 3 Chromatograms of Standard Added Dimethyl Sulfide

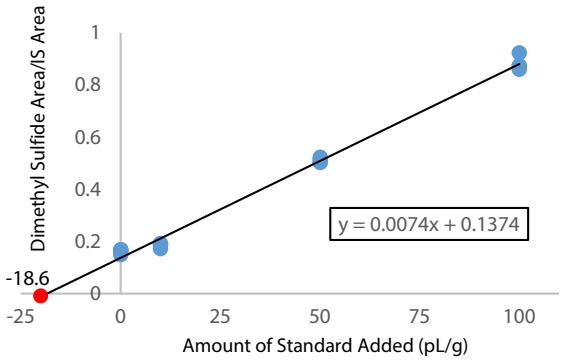

Fig. 4 Calibration Curve of the Dimethyl Sulfide in Beer

Conclusion

Results show the Nexis SCD-2030 can detect volatile sulfur compounds at trace levels without any concentration or sample pre-preparation steps.

In addition, we confirmed that different types of commercially available beers contain varying amounts and types of sulfur compounds that could affect flavor and aroma.

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