

Application News

No. G317A

Gas Chromatography

Analysis of Aroma Components in Beer Using HS-20 and Nexis™ GC-2030

Beer contains an extremely large number of aromatic compounds, or aroma components. In this article, nine aroma components, which have a large influence on the flavor of beer, including alcohols and esters, were analyzed in five types of commercial beer. A multivariate analysis (principal component analysis, hierarchical clustering analysis) of those analysis results was also conducted, and the beers were compared.

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■ Analysis Method

A standard solution for the calibration curve was prepared by diluting a mixed stock solution of aroma components with 4% ethanol. 10 g of this solution was introduced into a headspace vial, an internal standard was added, and the vial was sealed, after which a headspace analysis was conducted and the calibration curve was prepared. Real samples were prepared in the same manner as described above using 10 g of non-deaerated beer and the internal standard and then sealed in a headspace vial. A headspace analysis was conducted, and quantitation was done using the prepared calibration curve.



Appearance of Nexis™ GC-2030 + HS-20

■ Analysis Conditions

Table 1 shows the device composition and analysis conditions.

Table 1 Device Composition and Analysis Conditions

| Headspace sampler (HS-20) | | Gas chromatograph (Nexis GC-2030 / FID-2030) | |
|--|-----------|--|--|
| Mode | : Loop | Injection Mode | : Split |
| Oven Temperature | : 40 °C | Split Ratio | : 1 : 5 |
| Sample Line Temperature | : 70 °C | Carrier Gas | : He |
| Transfer Line Temperature | : 80 °C | Carrier Gas Control | : Column flowrate (5 mL/min) |
| Vial Pressure | : 150 kPa | Column | : SH-Wax (30 m×0.53 mm I.D., 1 μm) ^{*1} |
| Vial Heat-retention Time | : 45 min | Column Temp | : 40 °C (5 min) - 10 °C /min - 190 °C (5 min) |
| Vial Pressurization Time | : 1 min | Detector Temp | : 200 °C |
| Vial Pressurization Equilibrating Time | : 0.1 min | Detector Gas | : H ₂ 32 mL/min |
| Loading Time | : 0.5 min | | Make-up (He) 24 mL/min |
| Loading Pressurization Time | : 0.1 min | | Air 200 mL/min |
| Injection Time | : 0.5 min | | |
| Needle Flush Time | : 5 min | | |

*1 P/N: 221-75899-30

■ Analysis Results of 5 Commercial Beers

Fig. 1 shows a representative chromatogram, and Table 2 shows the quantitation results (average of n=3) of the aroma components of the five commercial beer samples.

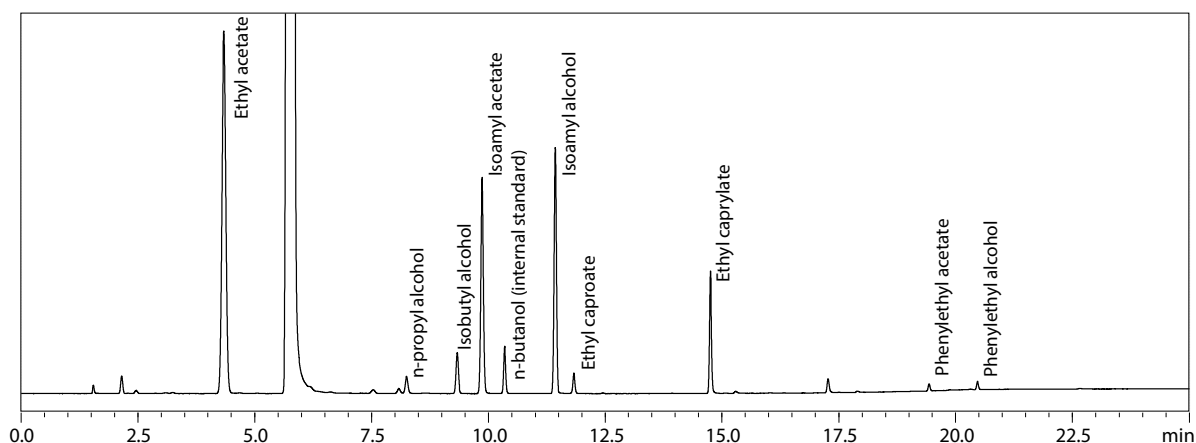


Fig. 1 Chromatogram of Beer

Table 2 Quantitation Results for Aroma Components (Unit: mg/L)

| Compound | Beer A | Beer B | Beer C | Beer D | Beer E |
|---------------------|--------|--------|--------|--------------|--------|
| Ethyl acetate | 21.065 | 32.552 | 12.584 | 30.386 | 13.825 |
| n-propyl alcohol | 11.342 | 11.217 | 11.985 | 23.662 | 9.360 |
| Isobutyl alcohol | 10.490 | 10.941 | 14.126 | 0.190 | 9.198 |
| Isoamyl acetate | 2.188 | 2.725 | 0.936 | 0.459 | 1.120 |
| Isoamyl alcohol | 62.552 | 52.284 | 59.169 | 59.692 | 54.575 |
| Ethyl caproate | 0.067 | 0.091 | 0.052 | 0.088 | 0.094 |
| Ethyl caprylate | 0.114 | 0.159 | 0.067 | 0.124 | 0.137 |
| Phenylethyl acetate | 0.350 | 0.808 | 0.125 | Not detected | 0.231 |
| Phenylethyl alcohol | 16.891 | 21.655 | 17.025 | 13.420 | 16.583 |

Multivariate Analysis Results and Study

Using eight components (excluding phenylethyl acetate) that were detected in all the beers in this analysis (n=3), a principal component analysis and hierarchical clustering analysis were carried out with the multivariate analysis software SIMCA® 15 (Infocom Corporation). Fig. 2 shows a score plot of the results. The five beer samples were clearly separated on the score plot, and the differences among the beers could be visualized. Fig. 3 shows a dendrogram. The degree of similarity could be visualized from the dendrogram.

The score plot and dendrogram show that Beer D differs greatly from the other four beers, suggesting that the concentration ratio of the eight components is different in Beer D from the other beers. Moreover, only Beer D was a top fermentation ale beer, and the other beers were bottom fermentation lager beers.

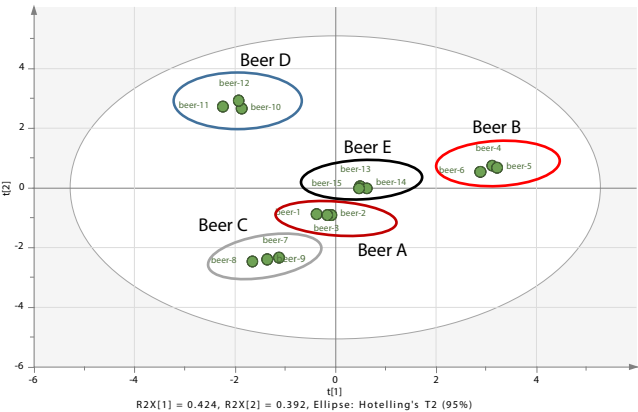


Fig. 2 Score Plot

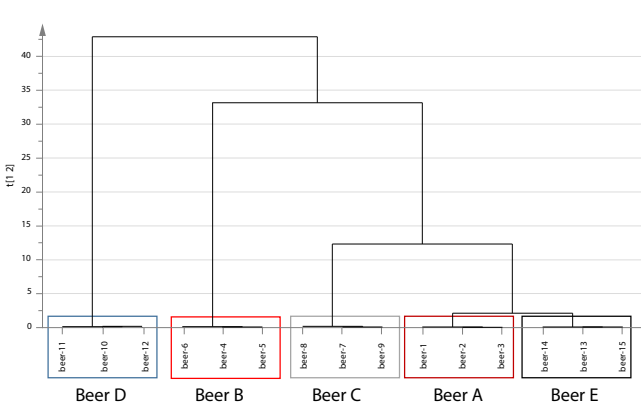


Fig. 3 Dendrogram

Conclusion

Nine aroma components in beer could be analyzed with high sensitivity, and differences in the component concentrations among the beers could be recognized. Simple visualization of the comparison of the beers was possible by a multivariate analysis of those analysis results.

<Reference>
Brewers Association of Japan, BCOJ Beer Analysis Methods (2013)

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Related Products

Some products may be updated to newer models.



> Nexis™ GC-2030
Gas Chromatograph



SH Series
> SH-Wax

Related Solutions

> Flavor Analysis

> Price Inquiry

> Product Inquiry

> Technical Service /
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> Other Inquiry