

Application Data Sheet

No. 141

GC-MS

Gas Chromatograph Mass Spectrometer

Analysis of Nootropics Using GC-MS(/MS) - Part 1

Nootropics is the general term for substances intended to improve cognitive function or abilities, such as certain drugs and supplements used to improve concentration or memory. Such nootropics are sometimes sold via the Internet without proper licensing, and there is concern that they could be harmful if used without the prescription of a physician because nootropics also include therapeutic drugs intended for epilepsy, attention-deficit hyperactivity disorder (ADHD), or depression.

Due to the relative newness of such substances, there are cases in which they are not registered in NIST, Wiley, or other mass spectral libraries commonly used for GC/MS analysis.

This Application Data Sheet describes an example of measuring 19 nootropics measurable by GC/MS.

Experimental

Standards of each component were dissolved in methanol to prepare a 10 µg/mL standard mixture solution. For components that cannot be measured without derivatization, 500 µL of the 10 µg/mL standard mixture solution was obtained, dried under a stream of nitrogen gas, and dissolved in 500 µL of BSTFA. Then the solutions were heated for 30 minutes at 60 °C for TMS derivatization.

Target compounds are listed in Table 1 and analytical conditions in Table 2.

Table 1: Target Compounds

Compound Name	Compound Name
Adrafinil	Vinpocetine
Atomoxetine	Pramiracetam
Aniracetam	Pregnenolone
Oxiracetam	Levetiracetam
Dihydroergotoxine	Etiracetam
Dehydroepiandrosterone (DHEA)	Atenolol
Nicergoline	Nadolol
Nimodipine	Idebenone
Nefiracetam	Furosemide
Piracetam	Tianeptine

Table 2: Analytical Conditions

GC-MS:	GCMS-QP2020	MS
Column:	SH-RxiTM-5Sil MS (30 m long, 0.25 mm I.D., df = 0.25 µm) (Shimadzu, P/N: 221-75940-30)	Interface Temp.: 280 °C
Glass Liner:	Deactivated splitless liner with wool (PN:221-48876-03)	Ion Source Temp.: 200 °C
GC		Solvent Cut Time: 2 min
Injection Temp.:	260 °C	Acquisition Time: 6 to 43 min
Column Oven Temp.:	60 °C (2 min) → (10 °C/min) → 320 °C (15 min)	Acquisition Mode: Scan
Carrier Gas:	Helium	Mass Range: m/z 40 to 600
Flow Control:	Linear velocity (45.6 cm/sec)	Event Time: 0.3 sec
Injection Mode:	Splitless	
High Pressure Injection:	250 kPa (1.5 min)	

Analytical Results

The total ion current chromatogram (TIC) obtained by measuring the underivatized 10 µg/mL standard mixture solution is shown in Fig. 1 and the TIC obtained by measuring the TMS derivatized 10 µg/mL standard mixture solution is shown in Fig. 2. Decomposition products were detected for nicergoline, adrafinil, and dihydroergotoxine. The decomposition products for adrafinil had the same retention time and mass spectral pattern as the decomposition products for modafinil. Because levetiracetam and etiracetam are optical isomers, they were detected at the same retention time and mass spectral pattern.

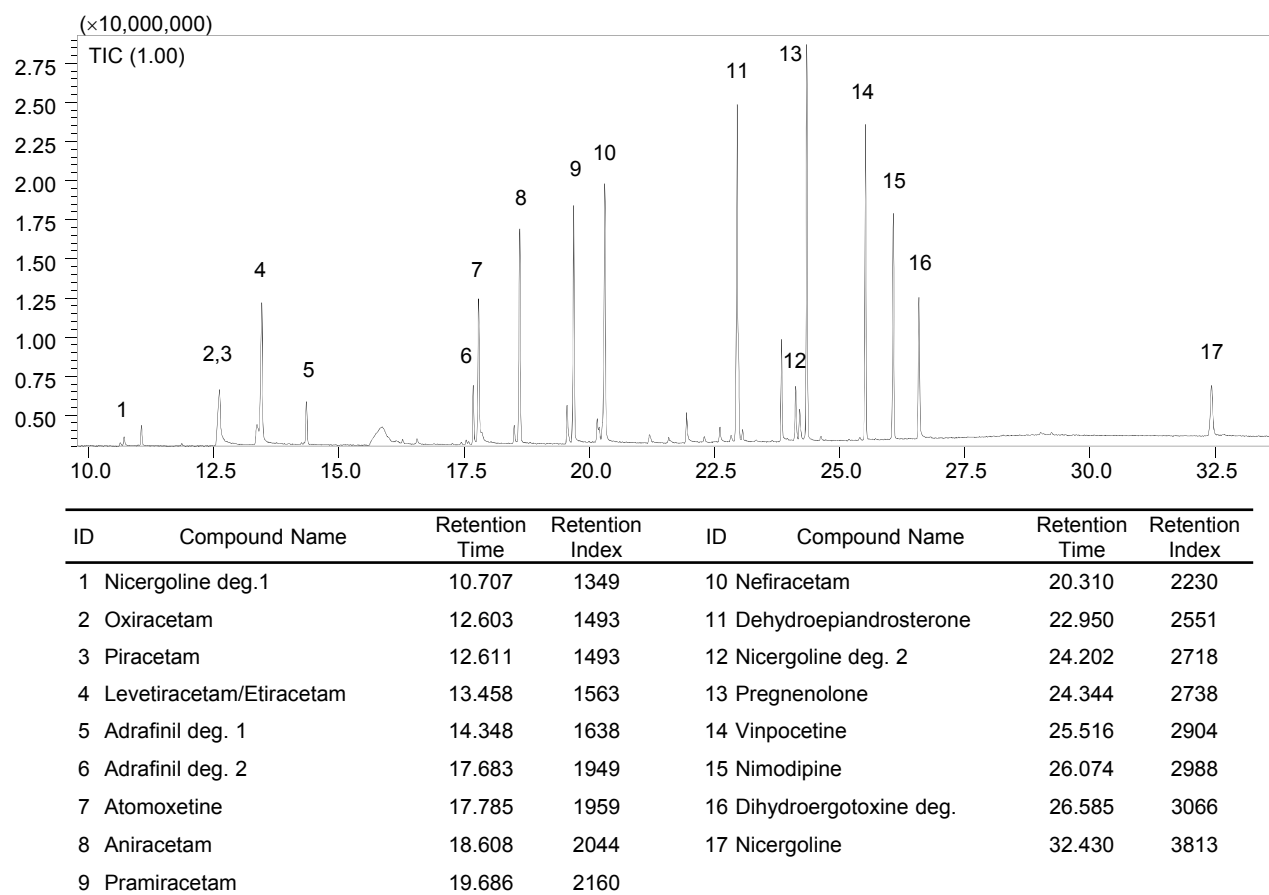


Fig. 1: Total Ion Current Chromatogram (TIC) of 10 µg/mL Standard Solution (Underivatized)

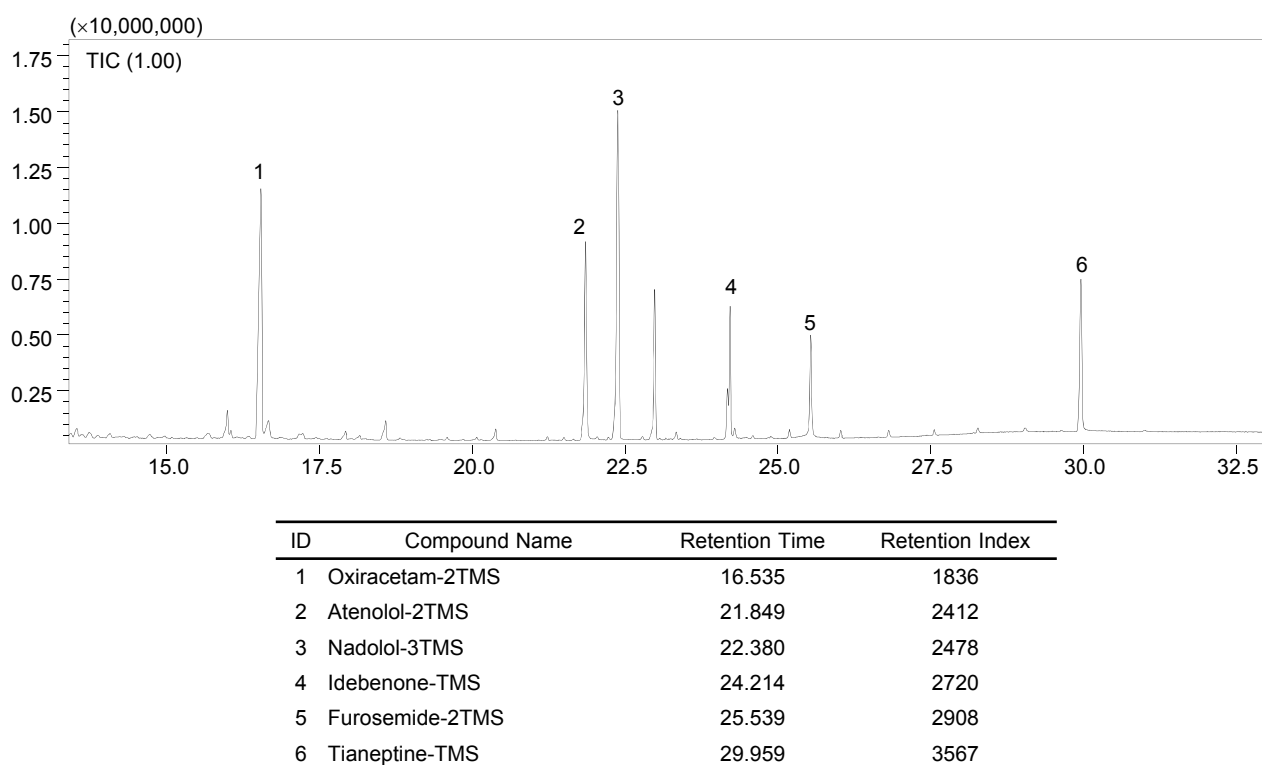


Fig. 2: Total Ion Current Chromatogram (TIC) of 10 µg/mL Standard Solution (TMS Derivatives)

Mass Spectra

The mass spectra for typical nootropics obtained by measuring the underivatized standard mixture are shown in Fig. 3 and the mass spectra obtained by measuring the TMS derivatized standard are shown in Fig. 4.

Underivatized

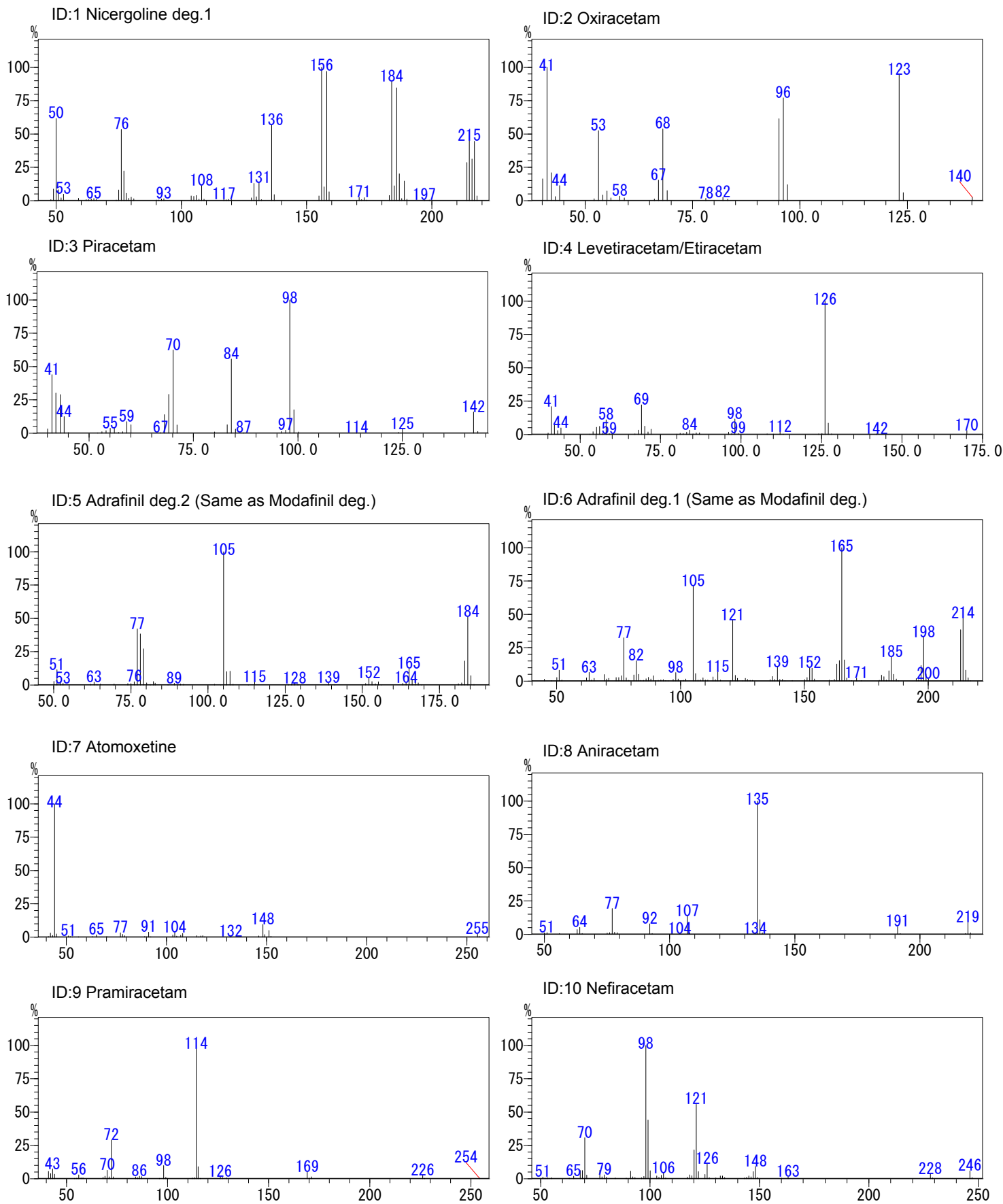


Fig. 3-1: Mass Spectra of Underivatized Typical Nootropics

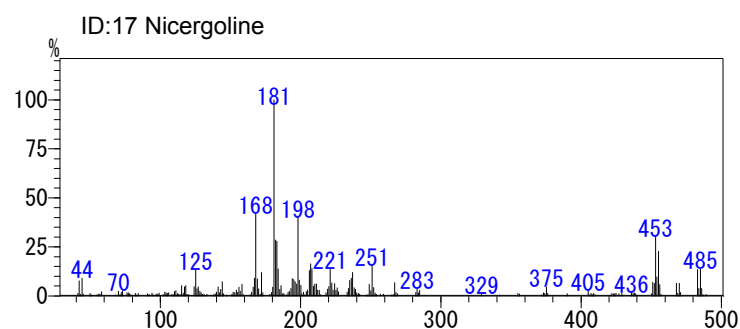
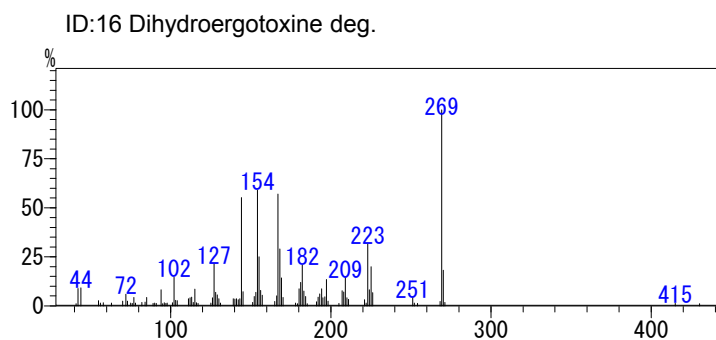
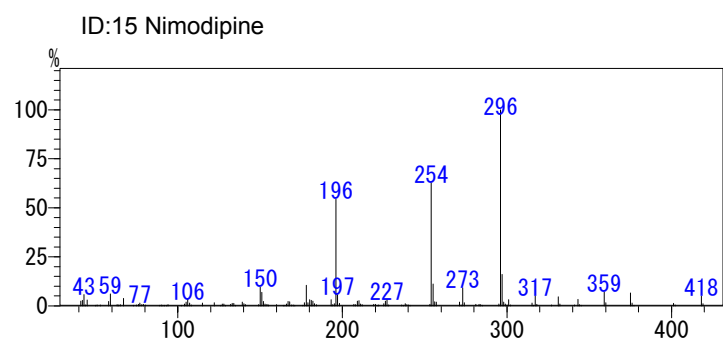
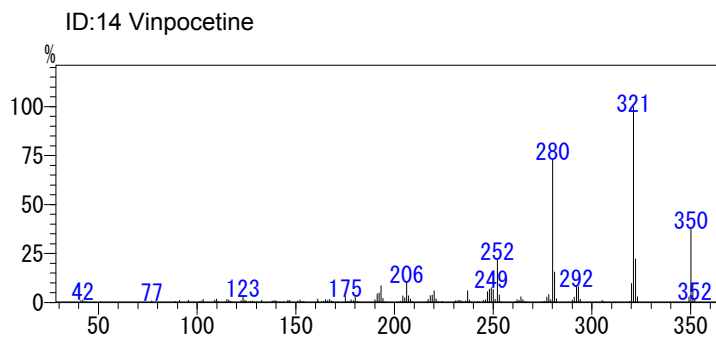
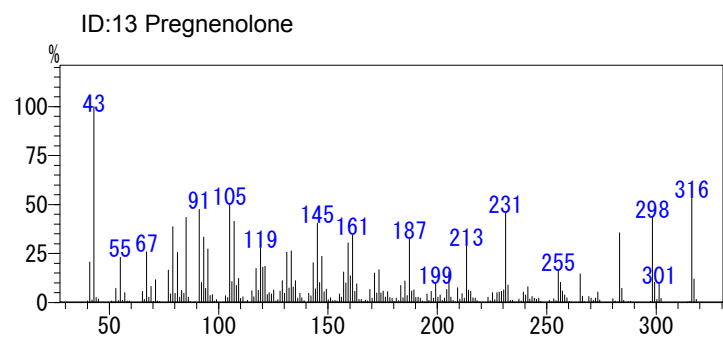
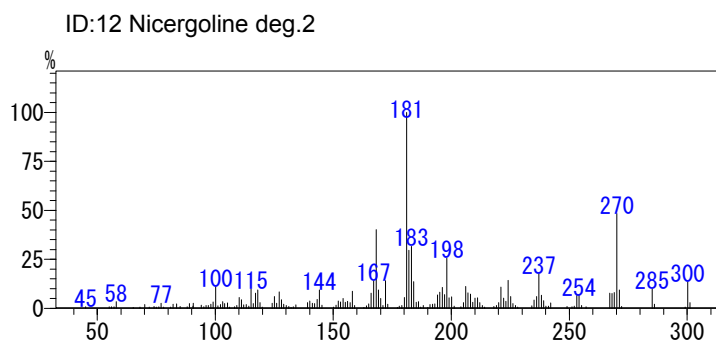
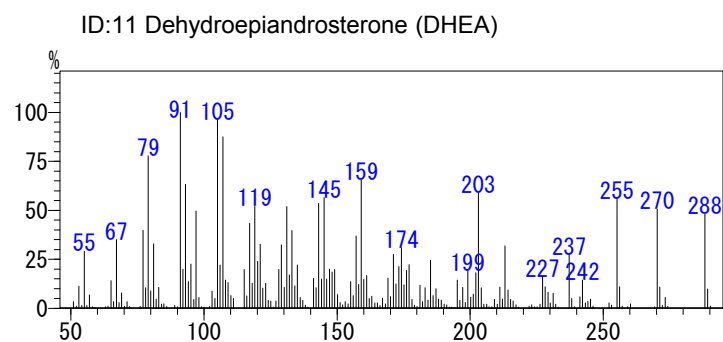


Fig. 3-2: Mass Spectra of Underivatized Typical Nootropics

TMS Derivatives

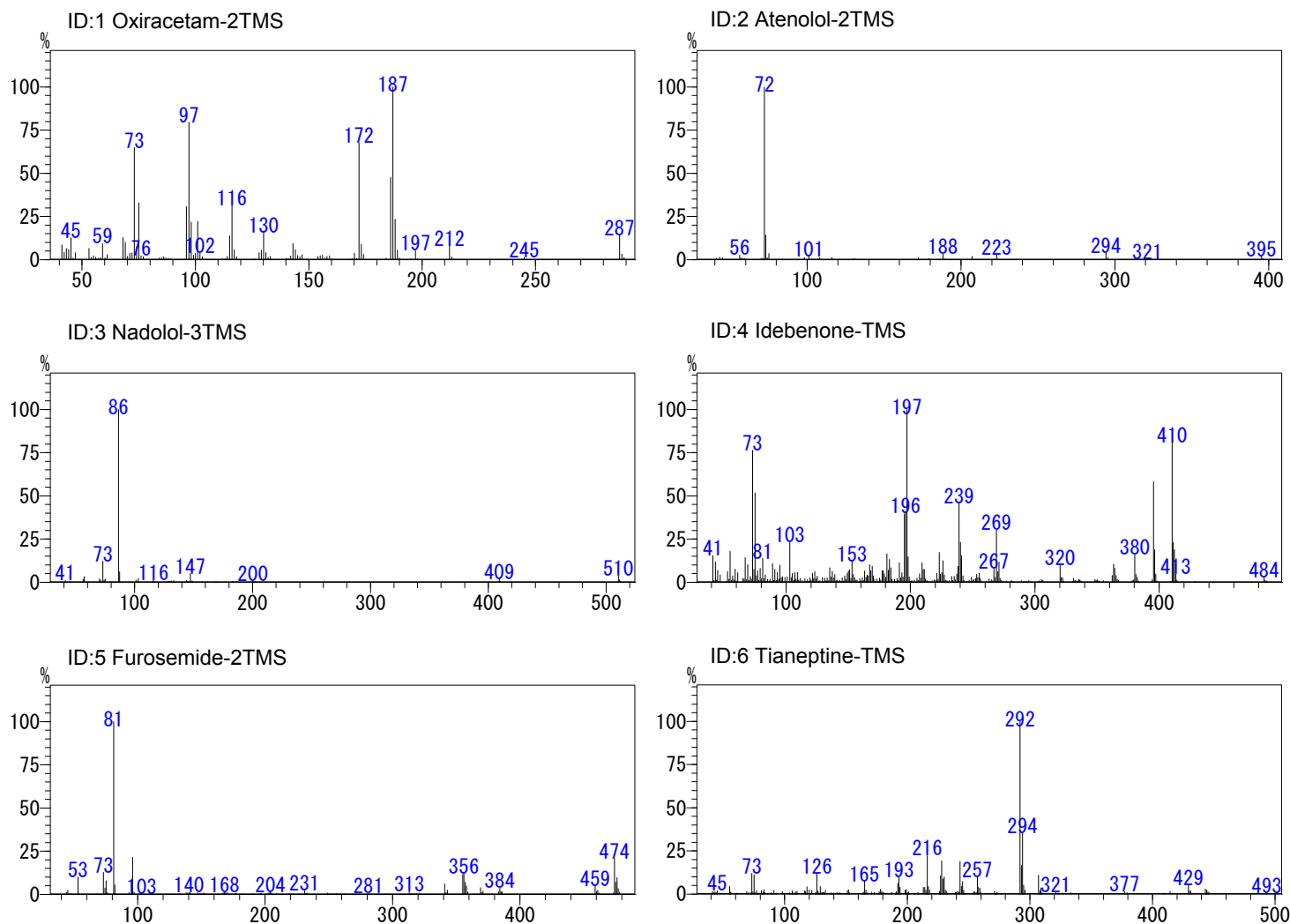


Fig. 4: Mass Spectra of TMS Derivatized Typical Nootropics

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First Edition: March 2018



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Some products may be updated to newer models.



> GCMS-QP2020 NX

Gas Chromatograph Mass Spectrometer

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