

AccuTOF™

Analysis of Drugs of Abuse by AccuTOF™ Dual ESI LC/TOF Mass Spectrometry

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1. INTRODUCTION

For identification of drugs of abuse in forensic science, the unambiguous identification of chemical substances is crucial. The new AccuTOF™ Dual ESI LC/TOF-MS system offers easy exact-mass measurements and elemental composition determinations. A robust design and stable time-of-flight mass analyzer are combined with a detection system that provides high sensitivity and high dynamic range^[1]. We used this system for analyzing the samples of drug substances containing the opiates and stimulants. The detection limit for codeine is 1.25 pg/μL. The mass accuracy is smaller than 3 ppm over a wide concentration range, from 1.25 pg/μL to 10 ng/μL.

2. EXPERIMENTAL

The system included a JEOL AccuTOF™ Dual ESI time-of-flight mass spectrometry system and an Agilent 1100 HPLC. All instruments were controlled by a JEOL MassCenter™. All solvents used were of HPLC grade. The standard solutions were purchased from Alltech (Deerfield, IL) and diluted in mobile phase A with the concentrations ranging from 1.25 ng/mL to 10 μg/mL.

Table 1. Chromatographic Conditions

Column:	Synergy Hydro-RP (1.0 x 150 mm, 4 μm)
Mobile phase:	A = 0.1 % formic acid with 5 % acetonitrile B = acetonitrile with 5 % water
Gradient:	started from 100% A to 20% B in 5 min, then to 50% B in 5 min, continued to 90% B in 2 min and hold for 3 min.
Flow rate:	0.1 mL/min
Injection:	10 μL

Table 2. MS Conditions

Source:	dual ESI
Ionization mode:	positive
Needle voltage:	2000 V
Orifice 1 voltage:	35 V, 55 V
Orifice 2 voltage:	7 V
Ring lens voltage:	5 V
Peak voltage:	1500 V
MCP voltage:	2400 V
Orifice 1 temp:	80 °C
Desolvating temp:	250 °C
Nebulizing gas:	3 L/min
Desolvating gas:	5 L/min

3. RESULTS

Figure 1 shows the mass chromatograms of $m/z \pm 0.05$ for 11 drugs of abuse separated by AccuTOF™ LC/MS system. The isomers morphine and hydromorphone have the same exact mass, but can be completely separated by HPLC. Amphetamine and methamphetamine were detected with orifice 1 voltage of 35 V. All other compounds were detected with the orifice 1 voltage of 55 V. This was achieved by using the “multi-function analysis” mode in AccuTOF™ MassCenter™ software. With this software, each component can be analyzed at its optimal conditions in just a single HPLC injection.

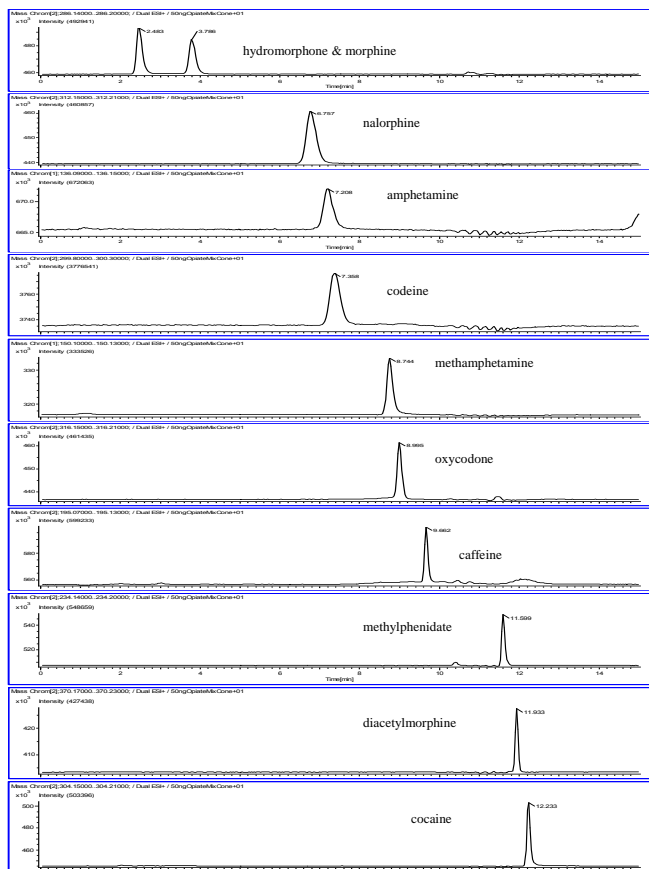


Figure 1. Mass chromatograms of $m/z \pm 0.05$ of 11 drugs of abuse.

The AccuTOF™ uses a data acquisition system that employs an ADC-based continuous digital averager. Therefore, statistical correction is unnecessary and a wide dynamic range has been achieved. This wide dynamic range has made quantitative analysis with TOF MS possible. Figure 2 shows the linearity for codeine over a wide concentration range, from 12.5 pg to 100 ng on-column amount. A linear correlation was found with an R^2 of 0.9997, indicating excellent linearity.

The wide dynamic range achieved by a continuous averager has also expanded the allowable concentration range in spectral measurements. Figure 3 shows the mass accuracy for the measurement of cocaine with concentrations ranging from 1.25 pg/ μ L to 10 ng/ μ L by using AccuTOF™ dual ESI ion source. The errors for all mass measurements are smaller than 3 ppm. The dual ESI ion source provides two ESI sprayers. The samples of drugs of abuse were introduced from the main sprayer. The reference solution, which contained nortriptyline and quinine, was introduced from the secondary sprayer. This permits the introduction of a reference compound without disturbing or suppressing the spray of the analytes^[2].

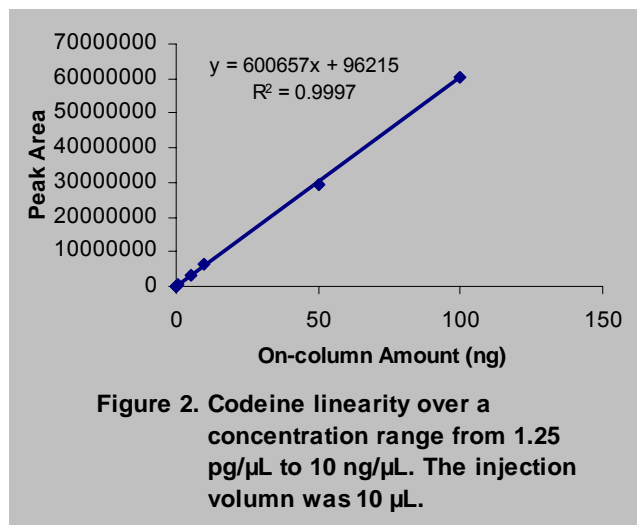


Figure 2. Codeine linearity over a concentration range from 1.25 pg/ μ L to 10 ng/ μ L. The injection volume was 10 μ L.

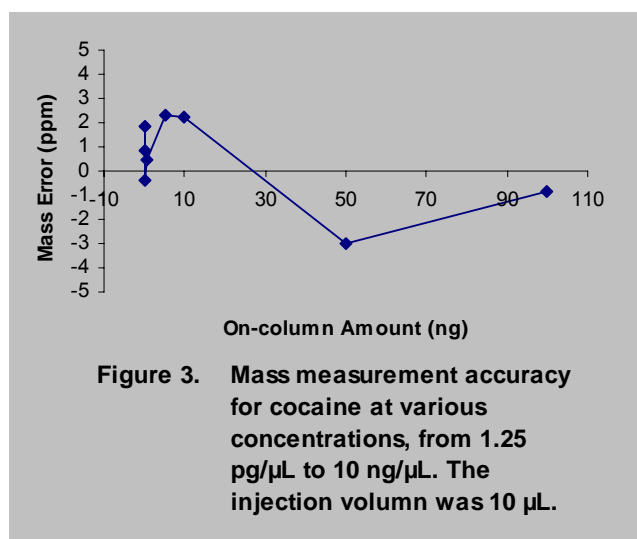


Figure 3. Mass measurement accuracy for cocaine at various concentrations, from 1.25 pg/ μ L to 10 ng/ μ L. The injection volume was 10 μ L.

4. CONCLUSION

The JEOL AccuTOF™ dual ESI LC/MS system provides with accurate mass measurement for identifying drugs of abuse. An error of smaller than 3 ppm for mass measurement can be achieved. A wide linear range was also achieved for quantitative analysis with very high sensitivity.

5. REFERENCES

- [1] Automated exact mass measurements and elemental composition determinations, JEOL USA, Inc. Application Notes, http://www.jeol.com/ms/docs/Accutof_aemm.pdf.
- [2] Introduction of dual ESI and corona ESI ion source. JEOL USA, Inc. Application Notes, http://www.jeol.com/ms/docs/Dual_esi.pdf.