
HamaMed-Repository
浜松医科大学学術機関リポジトリ
浜松医科大学
Hamamatsu University School of Medicine

POSITIVE- AND NEGATIVE-ION MASS SPECTRA OF ALKYL ESTER DERIVATIVES OF COCAINE

メタデータ	言語: English 出版者: 日本法中毒学会 公開日: 2013-08-27 キーワード (Ja): キーワード (En): Cocaine 作成者: Kumazawa, Takeshi, Watanabe, Kanako, Seno, Hiroshi, Ishii, Akira, Sato, Keizo, Suzuki, Osamu, Suzuki, Kanako メールアドレス: 所属:
URL	http://hdl.handle.net/10271/1719

Jpn. J. Forensic Toxicol. Vol.16, No.3, 1998

原　　報

POSITIVE- AND NEGATIVE-ION MASS SPECTRA OF ALKYL ESTER DERIVATIVES OF COCAINE

Takeshi KUMAZAWA*[1], Kanako WATANABE-SUZUKI [2], Hiroshi SENO[2], Akira ISHII[3], Keizo SATO[1] and Osamu SUZUKI[2]

[1]*Department of Legal Medicine, Showa University School of Medicine, 1−5−8 Hatanodai, Shinagawa-ku, Tokyo 142−8555, Japan*
[2]*Department of Legal Medicine, Hamamatsu University School of Medicine, 3600 Handa-cho, Hamamatsu 431−3192, Japan*
[3]*Department of Legal Medicine, Nagoya University Post Graduate School of Medicine, 65 Tsuruma-cho, Showa-ku, Nagoya 466−8550, Japan*

Received June 3, 1998
Accepted August 12, 1998

コカインとアルキルエステル類似体の正イオン・負イオンマススペクトル

熊澤武志[1]，鈴木(渡部)加奈子[2]，妹尾　洋[2]，石井　晃[3]，佐藤啓造[1]，鈴木　修[2]

[1]昭和大学医学部法医学教室　〒142−8555 東京都品川区旗の台１−５−８
[2]浜松医科大学法医学教室　〒431−3192 静岡県浜松市半田町3600番地
[3]名古屋大学医学部法医学教室　〒466−8550 愛知県名古屋市昭和区舞町65

Summary

Positive-ion electron impact (PIEI), positive-ion chemical ionization (PICI) and negative-ion chemical ionization (NICI) mass spectra of cocaine, cocaethylene, cocapropylene and cocabutylene, were presented, and each fragmentation mode was analyzed. In the PIEI mode, molecular ions appeared for all compounds. Cations at m/z M−121, corresponding to $[M-OCOC_6H_5]^+$, constituted base peaks for all compounds. In PICI mass spectra, all compounds showed intense $[M+1]^+$ quasi-molecular cations, which constituted base peaks, together with small peaks at m/z $[M+C_2H_5]^+$ and/or $[M+C_3H_5]^+$. Cations at m/z $[M-OCOC_6H_5]^+$ also appeared for all compounds. In the NICI mode, anions at m/z 121, corresponding to the $OCOC_6H_5$ moiety, constituted base peaks for all compounds. To check sensitivity, the intensities of peaks obtained by total ion monitoring (TIM) were compared with each other in the three modes. The detection limits for the compounds obtained by TIM in PIEI, PICI and NICI modes with a DB-1 fused silica capillary column were 11−103, 102−1300 and 185−1146 nmol on-column, respectively.

Key words: Cocaine; Cocaethylene; Cocapropylene; Cocabutylene; Mass Spectrometry; Negative-ion chemical ionization; Fragmentation pathway

*Correspondence should be addressed to Takeshi Kumazawa.
©1998 Japanese Association of Forensic Toxicology. All rights reserved. 0915−9606/98/$08.00

Introduction

Cocaine is a naturally occurring stimulant alkaloid derived from the leaves of *Erythroxylon coca*, a tree or shrub indigenous to western South America. Cocaine may be taken intranasally, injected intravenously, or smoked as cocaine "crack", and is one of the most frequently abused drugs. The present paper deals with positive ion electron impact (PIEI), positive ion chemical ionization (PICI) and negative ion chemical ionization (NICI) mass spectra of cocaine and its alkyl ester derivatives, cocapropylene, cocaethylene and cocabutylene, and each fragmentation pathway has been analyzed. Such systematic studies on these compounds in the three modes have never been reported to our knowledge.

Experimental

Materials

Pure powder of cocaine-HCl was purchased from Shionogi & Co., Ltd. (Osaka). Cocapropylene, cocaethylene and cocabutylene were synthesized from benzoylecgonine by the method of Roy *et al.* [1]. DB-1 fused silica capillary columns (30 m × 0.32 mm i.d., film thickness 0.25 μm) were obtained from J & W Scientific (Folsom, CA, USA). Other common chemicals used were of analytical grade.

Conditions of Gas chromatography (GC)/mass spectrometry (MS)

Mass spectra in the PIEI, PICI and NICI modes were recorded on a JEOL JMS-AX505H mass spectrometer (Tokyo) coupled to an HP5890 gas chromatograph (Hewlett-Packard Co., Palo Alto, CA, USA) with a computer-controlled data analysis system.

The MS conditions were: accelerating voltage 3.0 kV, ionization current 300 μA, separator temperature 260 ℃, and ion source temperature 240 ℃; in the PIEI mode, electron energy 70 eV; in the PICI and NICI modes, electron energy 200 eV, reagent gas methane and chamber pressure 1 Torr.

The GC conditions were: column temperature 140—260 ℃ (20 ℃/min); injection temperature 250 ℃ and helium flow-rate 3 ml/min. The samples were injected in the splitless mode and the splitter was opened after 1 min. Each compound was dissolved in methanol, and a 1-μl aliquot of it was subjected to GC/MS analysis.

Results and discussion

PIEI, PICI and NICI mass spectra of four compounds, and each probable fragmentation mode, are shown in Figs. 1—3.

In PIEI mass spectra (Fig. 1), molecular ions appeared for all compounds. Cations at m/z

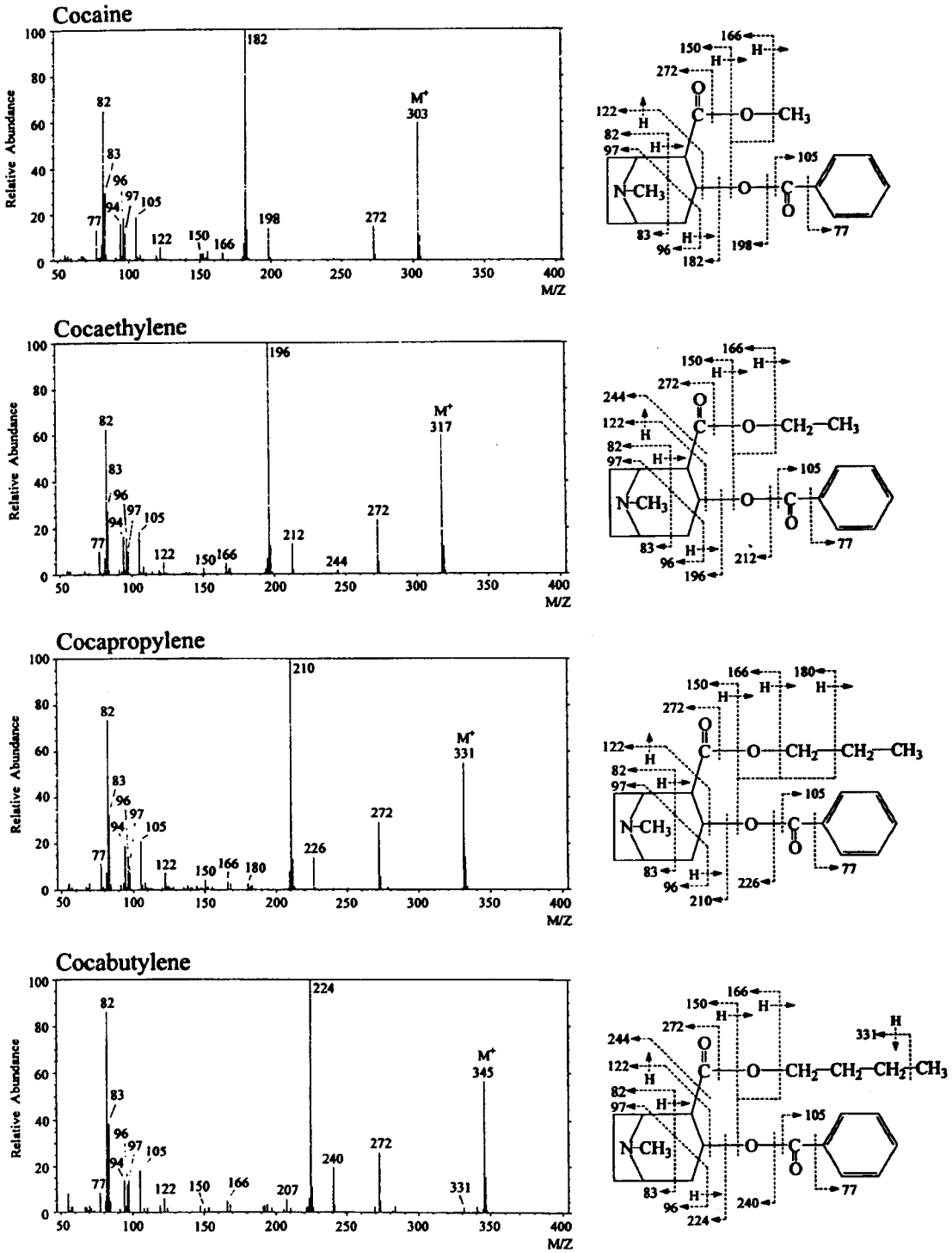

Fig. 1. PIEI mass spectra of cocaine, cocaethylene, cocapropylene and cocabutylene and their probable fragmentation modes.

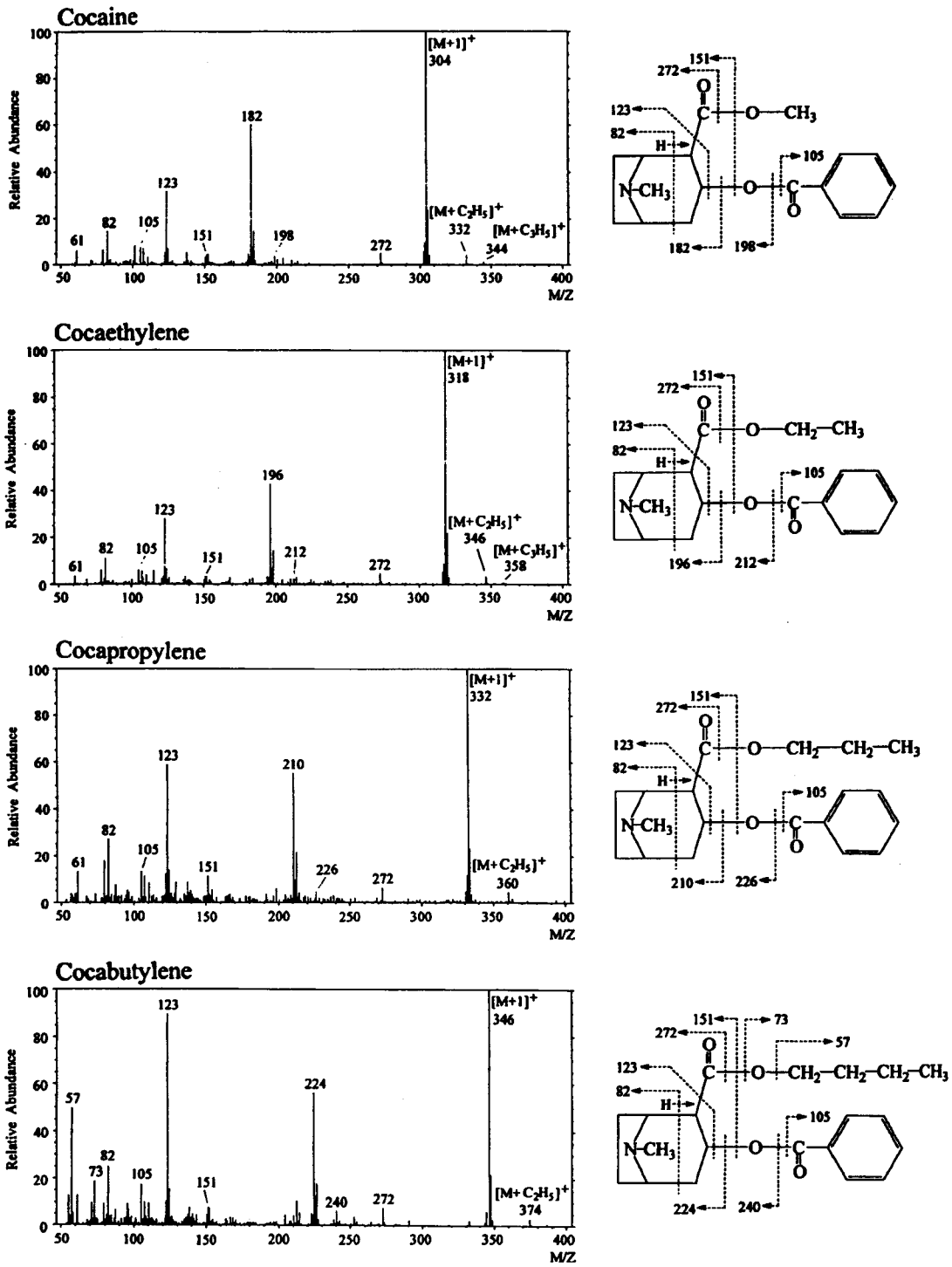

Fig. 2. PICI mass spectra of cocaine, cocaethylene, cocapropylene and cocabutylene and their probable fragmentation modes.

Negative CI

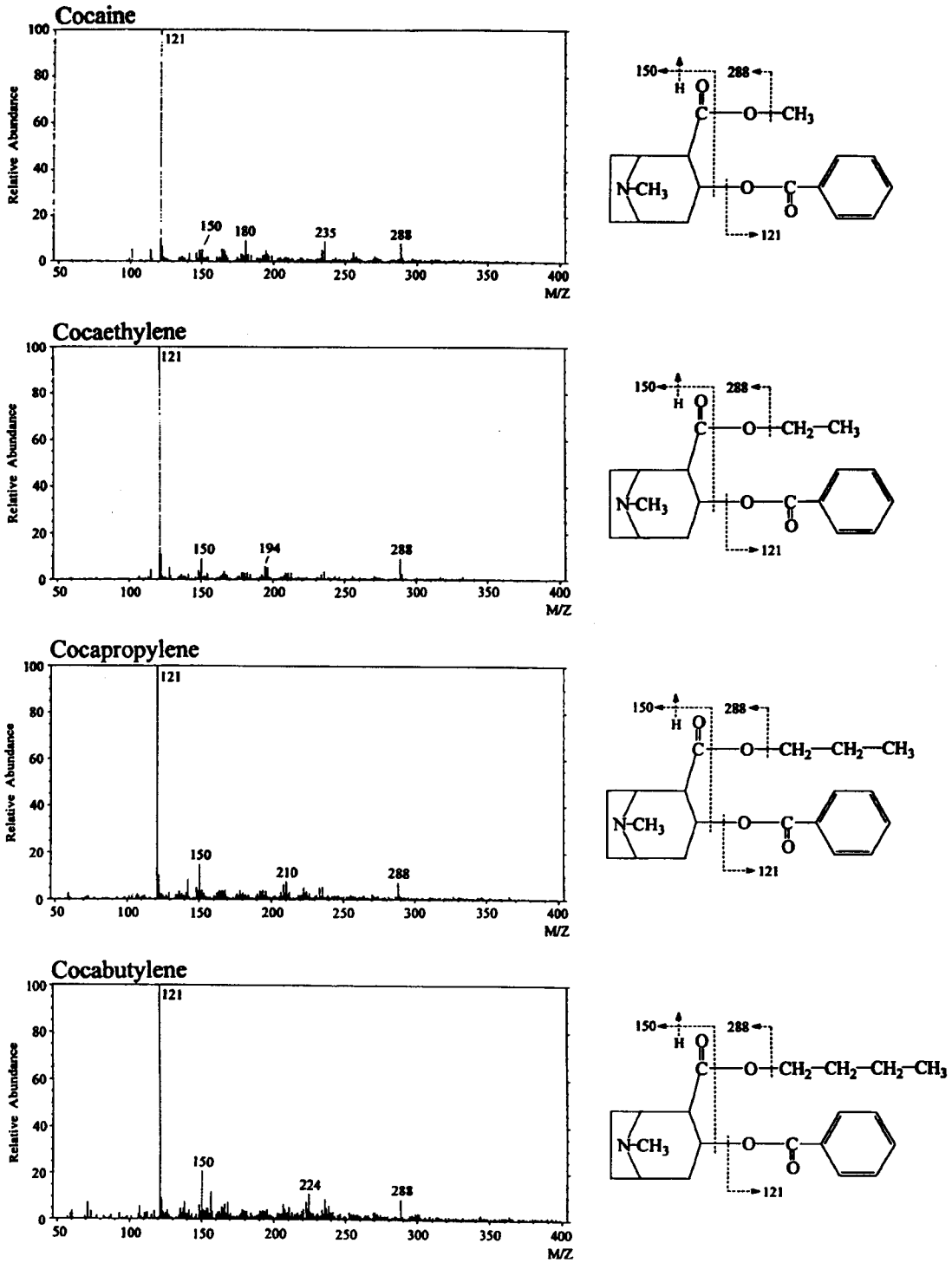

Fig. 3 . NICI mass spectra of cocaine, cocaethylene, cocapropylene and cocabutylene and their probable fragmentation modes.

M−121, corresponding to $[M-OCOC_6H_5]^+$, constituted base peaks for all compounds. There is also a structurally useful ion observed in common at m/z 82, which is formed by fragmentation of the bicyclic ring system to form a protonated methylpyrrole structure for all compounds. Additional cations to be mentioned are one at m/z 105, corresponding to the benzoyl ion, and one at m/z 272, corresponding to the loss of the alkyl-oxyl group from the molecular ion for all compounds. Small fragment peaks at m/z 77, 83, 94, 96, 97, 122, 150 and 166 were observed in common in four compounds.

In PICI mass spectra (Fig. 2), all compounds showed intense $[M+1]^+$ quasi-molecular cations, which constituted base peaks, together with small peaks at m/z $[M+C_2H_5]^+$ and/or $[M+C_3H_5]^+$. Cations at m/z M−121, 82, 105 and 272, which had been observed in PIEI mode (Fig. 1), also appeared for all compounds. Fragment peaks at m/z 123 and 151 were observed in common in four compounds.

NICI mode gave very similar mass spectra in four compounds, showing base peaks at m/z 121, corresponding to the $OCOC_6H_5$ moiety, and fragment peaks at m/z 150 and 288 (Fig. 3).

To check sensitivity of the present GC/MS method, the intensities of peaks obtained by total ion monitoring (TIM) were compared with each other in the three modes. The detection limits for all compounds in the PIEI, PICI and NICI modes were 11−103, 102−1300 and 185−1146 nmol on-column, respectively.

Screening of poisons or drugs is important in forensic science practice. Peaks at m/z 77, 82, 83, 105, 122 and 272 in the PIEI mode, and those at m/z 61, 82, 105, 123, 151 and 272 in the PICI mode, can be good indication for possibility of the presence of cocaine and its analogues.

More than 50% of cocaine abusers are reported to use ethanol [2, 3]. Cocaethylene can be formed *via* transesterification of the carbomethoxy group of cocaine in the liver by the co-administration of cocaine and alcohol [4]. Cocaine and cocaethylene produce qualitatively similar psychomotor stimulant effects, but cocaethylene is more potent than cocaine in such effects [5]. Therefore, it seems essential to measure cocaethylene together with precursor cocaine to give proper judgement on the cause of death for cocaine abusers.

In the present study, we have presented PIEI, PICI and NICI mass spectra of cocapropylene and cocabutylene. These compounds can be used as internal standard against cocaine and cocaethylene to be analyzed by GC, GC/MS and probably high-performance liquid chromatography/MS.

Acknowledgement

This work was supported by the Grant in Aid from Ministry of Education, Science, Sports and Culture of Japan (No. 10470122).

References

1) Roy, I. M., Jefferies, T. M., Threadgill, M. D. and Dewar, G. H.: Analysis of cocaine, benzoylecgonine, ecgonine methyl ester, ethylcocaine and norcocaine in human urine using HPLC with post-column ion-pair extraction and fluorescence detection. J Pharm Biomed Anal, **10**, 943–948 (1992).

2) Grant, B. F. and Harford, T. C.: Concurrent and simultaneous use of alcohol with cocaine: results of national survey. Drug Alcohol Depen, **25**, 97–104 (1990).

3) Weiss, R. D., Mirin, S. M., Griffin, M. L. and Michael, J. L.: Psychopathology in cocaine abusers. Changing trends. J Nerv Ment Dis, **176**, 719–725 (1988).

4) Dean, R. A., Christian, C. D., Sample, R. H. and Bosron, W. F.: Human liver cocaine esterases: ethanol-mediated formation of ethylcocaine. FASEB J, **5**, 2735–2739 (1991).

5) Hearn, W. L., Rose, S., Wagner, J., Ciarleglio, A. and Mash, D. C.: Cocaethylene is more potent than cocaine in mediating lethality. Pharm Biochem Behav, **39**, 531–533 (1991).