Improvement for high sensitivity of the drug screening by thermal desorption and pyrolysis combined with DART-MS (TDP/DART-MS)

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Introduction

TDP(thermal desorption and pyrolysis) / DART-MS is useful for comprehensive drug screening, since it isn't necessary complicated pre-treatment and analysis condition examination.

In our previous investigation, we reported as follows;
--- In blood cases, acetonitrile(ACN) deproteinization treated is required(Fig. 1-2), but urine sample isn't.
--- Quantitative analysis is available, but improvement for high sensitivity is necessary(Fig. 1-3).

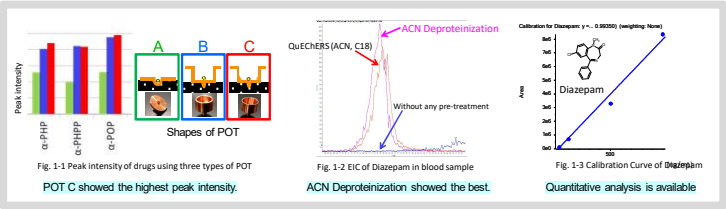

Fig.1 Our previous investigation

In this poster, we describe as a result of investigation of improvement for detection sensitivity
--- investigation of using "volatile compounds diffusion prevention cover (CAP, HOOD)"
--- investigation of heating rate for TDP device

Materials and Methods

Analytical methods

Sample solutions(100 µL) were put into the POT and heated from room temperature to 300 ℃ by TDP device.

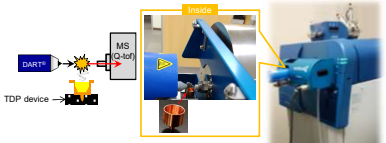

Fig.2 TDP/DART-MS system

Mass Spec. : TripleTOF™ 5600 system (SCIEX)
Mass range : *m/z* = 100-1000
MS measuring method : IDA (25IDA)

Ion Source : DART-SVP (IonSense)
Ionization gas : Helium
Helium gas temperature : 400 ℃

TDP device : ionRocket (BioChromato)
Temperature : RT → 300 ℃
Heating rate : 60 or 75 ℃/min
analysis time : 5 or 4 min

Samples

Drugs mixture std. solution and blood sample which was added drugs mixture std. solution

Table. Compounds list of drugs mixture std. solution

3-Hydroxyflunitrazepam	Brotizolam	Desmethyldiazepam	Fludiazepam	Lormetazepam	Oxazepam	Promethazine
7-Aminoflunitrazepam	Chlordiazepoxide	Desmethylflunitrazepam	Flunitrazepam	Medazepam	Quazepam	Mirtazapine
7-Aminonitrazepam	Clonazepam	Diazepam	Flurazepam	Mexazolam	Temazepam	
α-Hydroxytriazolam	Clotiazepam	Estazolam	Flutazolam	Midazolam	Triazolam	
Alprazolam	Cloxazolam	Ethyl loflazepate	Flutoprazepam	Nimetazepam	Zolpidem	
Bromazepam	Desalkylflurazepam	Etizolam	Haloxazolam	Nitrazepam	Zopiclone	

Results and discussions

Investigation of using "volatile compounds diffusion prevention cover"

By using drugs mixture std. solution (0.1 µg/mL, sample vol. 100 µL) , CAP and HOOD (Fig. 3), we investigate the detection sensitivity.

- The HOOD showed the best intensity (Fig. 4).
- The CAP, no effect were shown. it considered that vaporized compounds may be re-adsorbed to CAP.

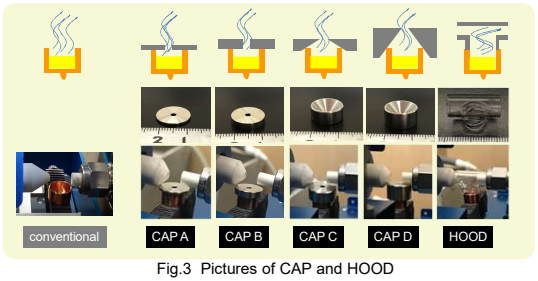

Fig.3 Pictures of CAP and HOOD

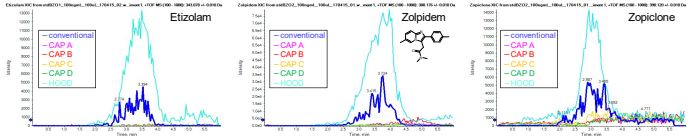

Fig.4 EIC of drugs mixture std. in ACN (0.1 µg/mL, sample vol. 100 µL)

By using blood samples which was added drugs mixture std. solution (0.1 µg/mL, ACN deproteinization treated, sample vol. 200 µL) and HOOD, we investigate the detection sensitivity.

- The HOOD showed the better intensity than conventional (Fig. 5).

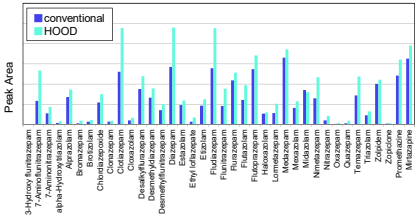

Fig.5 EIC peak area of blood sample (0.1 µg/mL, ACN deproteinization treated, sample vol. 200 µL)

Investigation of heating rate for TDP device

By using blood samples which was added drugs mixture std. solution (0.1 µg/mL, ACN deproteinization treated, sample vol. 200 µL), we investigate the heating rate of TDP device (60 ℃/min or 75 ℃/min).

- 75 ℃/min showed the higher intensity (Fig. 6) and MS/MS spectra showed more clear. Therefore it recognized that the qualitative ability improved.

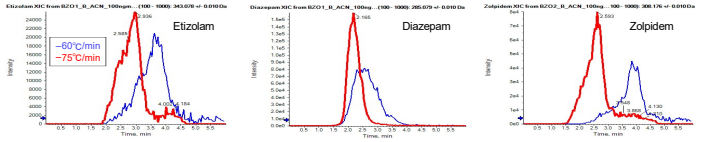

Fig.6 EIC of blood sample (0.1 µg/mL, ACN deproteinization treated, sample vol. 200 µL)

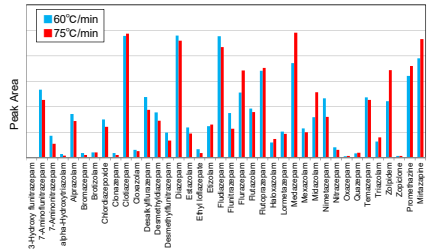

Fig.7 EIC peak area of blood sample (0.1 µg/mL, ACN deproteinization treated, sample vol. 200 µL)

Conclusion

For the drug screening using TDP/DART-MS, as a result of investigation of improvement for detection sensitivity we confirmed as follows,

--- Combining the HOOD showed the best detection intensity.
--- TDP device heating rate 75 ℃/min showed the better detection intensity. Moreover the qualitative ability improved.

In our next step, we investigate application to practical physician samples.

References

1. H.Abe, C.Takei, Y.Shida, M.Sakakura, T.Shiota, K.Suga, D.Yajima, H.Iwase; 64th ASMS Annual Conference, Poster WP266(2016)
2. H.Abe, C.Takei, Y.Shida, M.Sakakura, T.Shiota, K.Suga, D.Yajima, H.Iwase; 65th ASMS Annual Conference, Poster TP221(2017)