

Figure S1. Calibration curves for the analytes. All the calibration curves were assessed at 3.1, 6.2, 12.5, 25, 50, 62.5, 75, and 100 ng/mL. Mephedrone: 4-methylmethcathinone; Ephylone: N-ethylpentylone; 4-MEAPP: 4-methyl- α -ethylaminopentiophenone; PMA: para-methoxyamphetamine; PMMA: para-methoxymethamphetamine; DCK: deschloroketamine; 2-FDCK: 2-fluorodeschloroketamine.

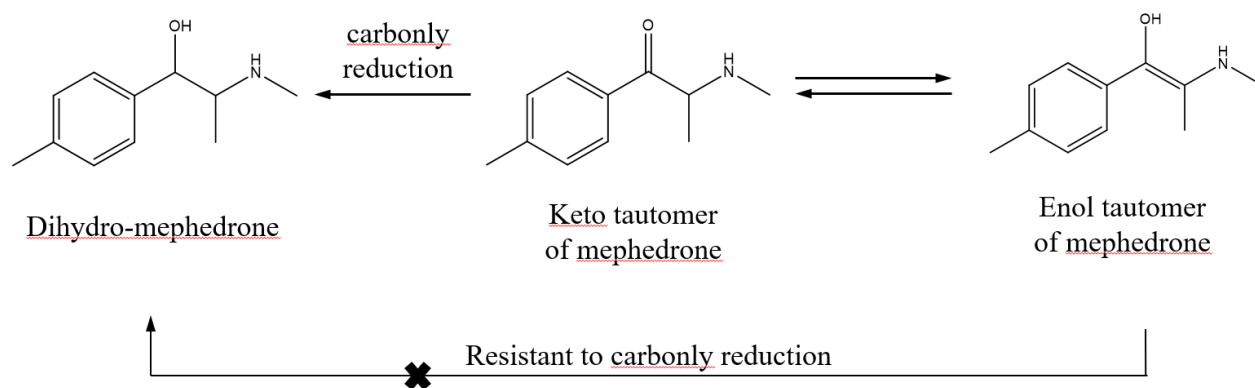


Figure S2. Keto-enol tautomers and carbonyl reduction from the keto tautomer of mephedrone.

Table S1: The details of the percentage of the target concentration for the analytes in different matrices and storage temperatures.

| Compound | Solvent | Storage temperature (°C) | % difference between days 0 and 7 | % difference between days 0 and 14 | % difference between days 0 and 30 | % difference between days 0 and 60 | % difference between days 0 and 90 | First unstable day of analysis |
|--------------------------|---------------------|--------------------------|-----------------------------------|------------------------------------|------------------------------------|------------------------------------|------------------------------------|--------------------------------|
| Mephedrone (50 ng/mL) | 50%MeOH | -20 | 4.88±4.35 | 8.48±0.61 | 8.89±5.47 | 7.87±0.89 | 2.78±2.29 | -- |
| | | 4 | 3.26±3.08 | 1.70±1.50 | 4.41±10.3 | -4.34±3.70 | -13.84±5.62 | -- |
| | | 25 | -3.93±2.67 | -49.53±1.62 | -88.87±0.82 | -98.91±0.12 | -99.53±0.24 | day 14 |
| | 50%MeOH (in 0.1%FA) | -20 | 5.16±3.67 | -3.98±3.07 | 3.98±2.26 | 1.70±5.57 | -5.09±2.75 | -- |
| | | 4 | 0.00±6.18 | -3.26±5.80 | 12.14±9.89 | 4.05±7.09 | -3.33±1.00 | -- |
| | | 25 | 1.24±3.46 | -0.07±3.76 | 19.06±2.04 | 16.51±1.04 | 15.01±6.15 | -- |
| | Urine | -20 | 1.98±4.24 | -5.36±2.53 | 7.67±8.16 | -1.65±6.49 | -12.17±3.85 | -- |
| | | 4 | -6.81±4.53 | -20.90±3.66 | -42.66±3.10 | -63.96±0.94 | -83.60±0.03 | day 14 |
| | | 25 | -68.65±1.21 | -96.43±0.06 | -99.67±0.30 | -99.93±0.11 | -99.60±0.20 | day 7 |
| Butylone (50 ng/mL) | 50%MeOH | -20 | -0.87±1.01 | 2.55±1.21 | 3.49±3.39 | 13.76±5.28 | 2.75±2.56 | -- |
| | | 4 | 3.83±1.93 | -1.34±3.69 | 8.59±3.85 | 8.86±6.96 | 2.55±7.67 | -- |
| | | 25 | 1.54±3.38 | -9.46±1.28 | -24.43±1.61 | -40.74±1.03 | -64.5±0.31 | day 30 |
| | 50%MeOH (in 0.1%FA) | -20 | -0.71±1.25 | -5.63±1.54 | -3.69±5.75 | -1.49±4.60 | -1.75±2.70 | -- |
| | | 4 | -4.01±2.61 | -4.72±6.99 | 9.64±11.38 | 6.86±8.11 | -4.40±0.98 | -- |
| | | 25 | -2.14±3.70 | -2.98±2.79 | 11.65±1.08 | 18.90±4.28 | 20.39±6.70 | day 90 |
| | Urine | -20 | 1.48±2.96 | -9.79±2.28 | 2.96±4.95 | 2.90±4.85 | -6.63±1.10 | -- |
| | | 4 | -1.67±5.99 | -8.82±6.91 | -10.11±2.71 | -6.31±1.90 | -30.01±1.64 | day 90 |
| | | 25 | -19.25±4.42 | -48.42±1.90 | -88.15±0.73 | -100±0.00 | -99.87±0.11 | day 14 |
| Pentylone (50 ng/mL) | 50%MeOH | -20 | 7.57±4.87 | 11.49±1.10 | 11.71±2.58 | 15.27±4.87 | 13.85±6.89 | -- |
| | | 4 | 7.07±4.42 | 3.43±1.83 | 17.42±8.15 | 12.92±5.07 | 11.56±7.15 | -- |
| | | 25 | 2.78±0.37 | -10.35±2.79 | -27.84±1.19 | -61.03±1.7 | -79.37±0.69 | day 30 |
| | 50%MeOH (in 0.1%FA) | -20 | 9.62±6.87 | 4.85±1.82 | 9.05±3.15 | 8.34±5.43 | 12.19±3.33 | -- |
| | | 4 | 3.92±2.06 | 3.49±5.35 | 9.48±15.16 | 14.04±5.79 | 10.83±0.54 | -- |
| | | 25 | 4.92±2.79 | 6.91±4.53 | 22.59±0.99 | 26.09±1.46* | 37.78±4.86 | day 30 |
| | Urine | -20 | 2.73±1.88 | -3.96±3.62 | 6.21±8.05 | 5.66±4.65 | 0.89±1.24 | -- |
| | | 4 | 1.77±5.76 | -2.39±4.69 | -4.30±6.42 | -16.71±2.56 | -35.54±1.24 | day 90 |
| | | 25 | -27.22±2.19 | -60.16±1.44 | -95.23±0.24 | -100.00±0.00 | -100.00±0.00 | day 7 |
| Eutylone (50 ng/mL) | 50%MeOH | -20 | 7.20±2.15 | 7.13±2.88 | -1.20±2.67 | 15.68±2.04 | 10.45±6.36 | -- |
| | | 4 | 8.05±2.12 | 0.21±3.92 | 11.65±4.60 | 12.85±4.53 | 9.04±8.90 | -- |
| | | 25 | 8.97±5.02 | -5.93±1.32 | -13.70±3.35 | -25.78±2.29 | -50.21±0.37 | day 60 |
| | 50%MeOH (in 0.1%FA) | -20 | 15.04±1.17 | -0.85±0.77 | 2.27±6.37 | 7.94±4.02 | 6.52±7.35 | -- |
| | | 4 | 8.79±6.67 | -1.21±6.11 | 15.89±10.61 | 11.56±6.86 | 3.26±1.60 | -- |
| | | 25 | 10.00±4.61 | -0.43±2.22 | 16.03±7.89 | 26.74±3.54 | 25.18±10.92 | day 60 |
| | Urine | -20 | 10.67±5.32 | -12.33±2.54 | 3.25±1.28 | 2.45±0.75 | -4.64±1.69 | -- |
| | | 4 | 1.79±3.91 | -9.28±5.27 | -8.08±2.49 | -2.52±3.38 | -23.92±0.64* | day 90 |
| | | 25 | -15.51±1.73 | -42.74±3.10 | -79.26±1.09* | -99.14±0.11 | -99.80±0.00 | day 14 |
| 50%MeOH | -20 | 6.46±2.58 | 5.17±2.32 | 1.77±0.66 | 11.09±1.71 | 5.17±2.86 | -- | |

| | | | | | | | | |
|------------------------|---------------------|--------------------|--------------------|--------------------|---------------------|--------------------|--------------------|--------|
| Ephylone (50 ng/mL) | 50%MeOH (in 0.1%FA) | 4 | 8.78±2.35 | -1.77±2.93 | 13.47±2.96 | 7.01±5.61 | 0.61±6.65 | -- |
| | | 25 | 9.80±2.35 | -13.54±2.18 | -25.17±2.29 | -48.57±2.16 | -71.02±0.41 | day 30 |
| | | -20 | 8.76±3.82 | -7.73±3.00 | 0.77±1.86 | -0.71±5.42 | -8.05±3.10 | -- |
| | Urine | 4 | -0.97±2.82 | -9.47±6.23 | 11.34±5.76 | 2.64±5.13 | -4.77±3.06 | -- |
| | | 25 | 2.90±3.70 | -9.15±2.53 | 11.92±4.19 | 14.05±0.51 | 16.11±1.96 | -- |
| | | -20 | 6.19±1.67 | -14.15±0.52 | 9.91±6.38 | -1.04±5.38 | -10.17±2.36 | -- |
| | | 4 | 2.54±7.06 | -11.08±2.93 | -5.48±4.77 | -11.08±1.37 | -36.11±1.47 | day 90 |
| 25 | -24.32±0.90 | -53.00±1.85 | -89.44±0.52 | -99.93±0.11 | -99.93±0.11 | day 7 | | |
| 4-MEAPP (50 ng/mL) | 50%MeOH | -20 | -2.09±1.85 | 1.40±0.50 | -1.08±5.49 | 4.50±2.58 | -5.64±3.11 | -- |
| | | 4 | 0.89±1.81 | -5.01±2.45 | 3.30±1.90 | -0.06±3.88 | -10.34±6.34 | -- |
| | | 25 | -1.59±2.23 | -21.05±3.44 | -44.71±1.05 | -72.92±1.40 | -90.3±0.19 | day 14 |
| | 50%MeOH (in 0.1%FA) | -20 | 0.86±3.10 | -8.12±0.91 | -9.23±5.65 | -6.28±2.68 | -13.05±1.51 | -- |
| | | 4 | -2.22±5.00 | -9.60±5.84 | 8.55±9.79 | -0.98±6.76 | -11.14±2.62 | -- |
| | | 25 | -1.23±1.33 | -6.34±4.06 | 7.2±1.57 | 10.71±4.06 | 7.94±1.02 | -- |
| | | -20 | -2.76±4.13 | -11.41±1.42 | 2.82±5.97 | -5.20±6.97 | -17.87±5.16 | -- |
| Urine | 4 | -2.26±4.80 | -11.85±5.40 | -16.36±2.14 | -29.59±1.28 | -53.98±1.09 | day 60 | |
| | 25 | -37.81±1.52 | -74.29±1.69 | -98.43±0.11 | -100.00±0.00 | -99.69±0.29 | day 7 | |
| | 25 | 5.85±1.90 | 5.37±4.00 | 3.33±2.12 | 0.88±1.93 | -2.65±1.87 | -- | |
| PMA (50 ng/mL) | 50%MeOH | 4 | 6.94±2.41 | 4.08±1.27 | 0.27±6.20 | 6.87±3.70 | 0.34±1.36 | -- |
| | | 25 | 6.67±4.17 | 2.93±1.74 | 1.50±2.26 | 7.55±2.32 | 3.13±3.06 | -- |
| | | -20 | 4.30±2.14 | 2.22±1.72 | -3.36±0.35 | -4.51±3.78 | -7.06±3.04 | -- |
| | 50%MeOH (in 0.1%FA) | 4 | 5.78±0.91 | 1.75±0.91 | -1.41±3.79 | 1.14±1.51 | -6.39±2.62 | -- |
| | | 25 | 4.10±2.25 | -0.13±0.61 | 5.51±2.71 | 10.09±1.72 | 17.82±1.45 | -- |
| | | -20 | 0.19±1.35 | -11.05±1.56 | -0.96±5.00 | -9.06±1.24 | -14.72±0.68 | -- |
| | | 4 | -0.06±1.46 | -5.46±0.59 | -6.11±2.42 | 4.18±1.42 | -7.39±3.32 | -- |
| Urine | 25 | 7.39±1.84 | -8.87±3.41 | -6.17±2.06 | 6.88±1.31 | -10.48±0.87 | -- | |
| | -20 | 10.13±1.56 | 11.69±1.12 | 10.35±1.79 | 19.73±1.69 | 9.75±1.49 | -- | |
| | 4 | 14.15±2.63 | 6.92±1.52 | 10.35±5.28 | 12.58±0.59 | 16.60±3.97 | -- | |
| PMMA (50 ng/mL) | 50%MeOH | 25 | 13.33±1.86 | 9.23±3.88 | 11.02±0.77 | 11.69±2.68 | 18.32±3.35 | -- |
| | | -20 | 5.44±1.76 | 5.08±1.21 | 6.09±4.04 | 12.69±0.58 | 6.09±2.63 | -- |
| | | 4 | 7.47±0.78 | 2.47±2.30 | 9.14±4.26 | 14.94±0.33 | 8.92±3.91 | -- |
| | 50%MeOH (in 0.1%FA) | 25 | 7.76±2.90 | 6.02±3.33 | 14.14±8.92 | 31.91±3.18 | 36.84±1.32 | day 60 |
| | | -20 | 7.36±4.61 | -3.79±1.46 | 9.36±3.94 | 11.72±4.34 | -2.00±0.43 | -- |
| | | 4 | 8.01±2.44 | 3.65±1.26 | 3.29±3.90 | 15.30±4.41 | 0.64±1.38 | -- |
| | | 25 | 8.72±3.54 | 0.29±1.73 | 0.57±3.33 | 16.01±0.43 | 3.00±3.84 | -- |
| DCK (25 ng/mL) | 50%MeOH | -20 | 4.74±5.28 | 1.35±1.24 | 8.12±0.85 | 4.19±1.64 | 3.25±4.30 | -- |
| | | 4 | 6.09±4.71 | -0.41±1.17 | 3.79±2.70 | 5.55±0.81 | 2.71±1.46 | -- |
| | | 25 | 6.22±2.94 | 0.27±0.00 | 7.71±1.88 | 14.61±3.10 | 13.80±1.54 | -- |
| | 50%MeOH (in 0.1%FA) | -20 | 2.14±2.85 | -2.27±3.24 | 1.60±4.10 | -4.41±1.90 | -0.94±3.83 | -- |
| | | 4 | 6.15±1.52 | -4.68±2.28 | 5.21±1.41 | 4.28±1.45 | 2.81±4.10 | -- |
| | | 25 | 3.07±4.19 | -1.47±3.24 | 8.56±2.35 | 14.30±1.45 | 27.67±6.22 | day 90 |
| | | -20 | -0.79±2.05 | -8.66±3.88 | 0.92±4.14 | -3.67±4.60 | -9.58±3.88 | -- |
| Urine | 4 | 3.28±5.84 | -4.72±0.79 | -3.15±4.17 | 0.26±3.55 | -1.97±1.97 | -- | |
| | 25 | 8.14±5.59 | -9.84±1.42 | -3.02±1.27 | -8.14±0.60 | -3.15±3.88 | -- | |

| | | | | | | | | |
|----------------------|---------------------|-----|------------|------------|------------|-------------------|-------------------|--------|
| 2-FDCK (25 ng/mL) | 50%MeOH | -20 | -4.15±5.00 | -2.07±2.16 | 0.52±2.92 | 2.33±0.22 | -0.52±5.64 | -- |
| | | 4 | -1.94±4.47 | -4.79±3.75 | -7.77±1.84 | 7.38±5.25 | 2.72±4.28 | -- |
| | | 25 | 1.55±1.57 | -0.65±2.37 | -1.68±3.11 | 14.51±2.50 | 11.14±6.25 | -- |
| | 50%MeOH (in 0.1%FA) | -20 | 4.52±4.87 | 8.76±4.00 | 3.67±10.59 | 3.11±4.33 | 6.64±6.97 | -- |
| | | 4 | 9.89±3.40 | -0.14±0.65 | 5.51±1.53 | 10.03±3.60 | 12.99±1.29 | -- |
| | | 25 | 12.15±3.60 | 8.19±3.29 | 9.89±8.29 | 24.58±0.85 | 41.67±2.82 | day 60 |
| | Urine | -20 | -0.66±5.84 | -9.84±2.58 | -5.38±1.86 | 1.71±5.52 | -6.04±2.17 | -- |
| | | 4 | 3.02±6.05 | -4.59±3.30 | -4.46±1.49 | 0.66±4.70 | 3.54±1.72 | -- |
| | | 25 | -2.76±4.77 | -6.43±0.82 | -5.25±4.34 | 2.23±2.77 | 4.59±4.60 | -- |

Bold* values indicate the change in concentration > 20%. Mephedrone: 4-methylmethcathinone; Ephylone: N-ethylpentylone; 4-MEAPP: 4-methyl- α -ethylaminopentiophenone; PMA: para-methoxyamphetamine; PMMA: para-methoxymethamphetamine; DCK: deschloroketamine; 2-FDCK: 2-fluorodeschloroketamine; 50%MeOH: 50% methanol and 50% water; 50%MeOH (in 0.1%FA): 50% methanol/water with 0.1% formic acid.