Poster Reprint

ASMS 2023
Poster number WP 231

An Innovative Approach to Q-TOF High Resolution Accurate Mass Analyte Screening Using an Improved Software Algorithm and Screener Tool

Peter JW Stone

Agilent Technologies, Santa Clara, CA, United States

Introduction

High resolution, accurate mass screening (HRAM) for high numbers of targets using a Q-TOF Mass Spectrometer can be difficult to reproducibly achieve in a single analysis due to the variability of sample matrices, the concentration ranges and the nature of the data mining algorithms.

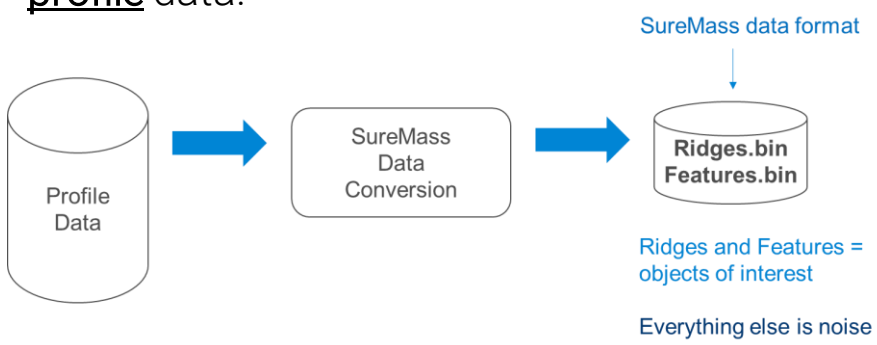
This poster illustrates a proof of principle ability to detect a panel of over 200+ targets and suspects reproducibly in a single 8-minute analysis at high and low concentrations using a newly improved software mining algorithm SureMass.

The results presented herein this poster demonstrate near 100% identification of a comprehensive panel reproducibly to below 5ppm mass accuracy over a wide range of typical working concentrations.

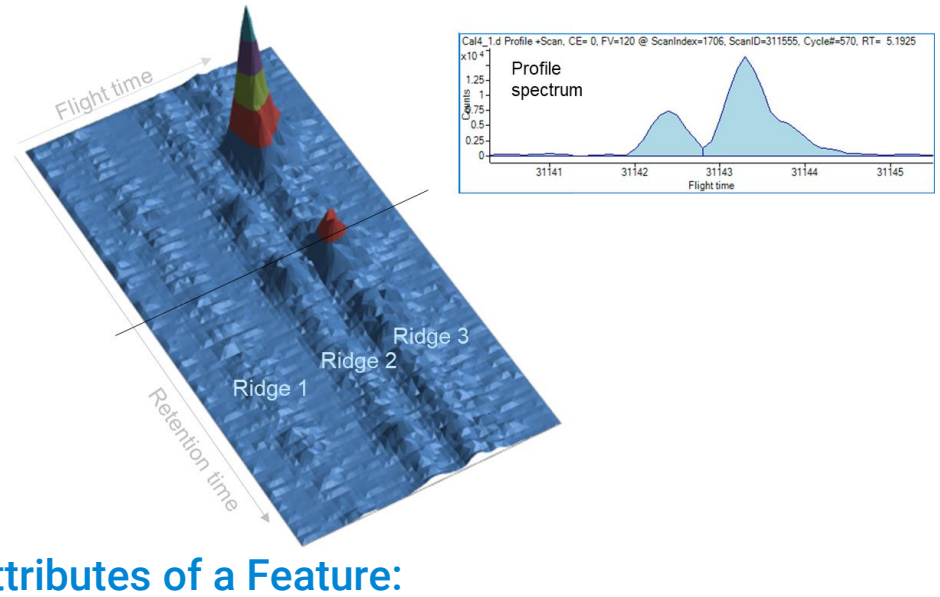
SureMass Data Mining

What is SureMass?

- A low-level data processing algorithm designed to extract maximum information from accurate mass profile data.



- **Ridges and Features**



Attributes of a Feature:

- Scan space (Collision Energy, Fragmentor Voltage)
- Assigned flight time and Retention Time
- Abundance profile and Flight time profile
- Assigned *m/z*

SureMass Data Mining (cont[d].)

Why SureMass?

Both Profile and Centroid data formats have individual Issues.

1. Speed - Profile data analysis is painfully slow
2. Mass Accuracy - Centroid data analysis is fast, but gives poor mass accuracy at high abundance levels
3. Saturation – Centroid can't handle Saturation (Mass shifts, Split peaks, False negatives)

SureMass handles saturation gracefully (No high-abundance negatives)

Experimental

Outline.

Repeat injections (N=10) containing 200+ positive polarity targets were injected onto an 8-minute reverse phase chromatography gradient for separation from isobars and interferents that may be present. Column phase was Poroshell 120 EC C18 100 x 2.1mm. (Aqueous MP= 0.01% FA, 5mM Amm F).

Pure solvent standard mixes at high and low concentrations relative to minimal and high working concentrations for the respective target classes included in this study were analyzed using an Agilent 6546 Q-TOF LC/MS operating in MS-only or All Ions positive polarity mode to attain the identification results.

Data mining software SureMass was utilized to identify and report low false negative and positive percentage rates via a novel screener software tool.

HPLC Gradient Conditions.

0.00 min 10% Methanol; 1.00 min 15% Methanol;
4.00 min 50% Methanol; 6.00 min 95% Methanol;
8.00 min 95% Methanol. 8 min total run time.

MS Conditions (AJS-ESI Positive Polarity).

Data collection Rate:

- 3x data points/s (MS-only)
- 9x data points/s (All Ions, CE = 0, 20, 30 eV)

Source Settings at HPLC Flow Rate of 0.5 mL/min:

- Nozzle Voltage: 500V
- Sheath Gas Temp/Flow: 360ºC; 11L/min
- Dry Gas Temp/Flow: 300ºC; 10 L/min
- Nebulizer Pressure: 55 psi
- Capillary Voltage: 3750 V

Discussion

Screener Tool.

The Screener Tool Graphical User Interface is an integral element of MassHunter Quantitative Analysis Software.

It displays each sample in the batch interactively and simplifies the analyst review process by displaying the targets and suspects using a color-coded 'traffic light' system of green, amber and red. Green=positive, amber=review required, Red= negative. Filters are provided to simplify the review process further.

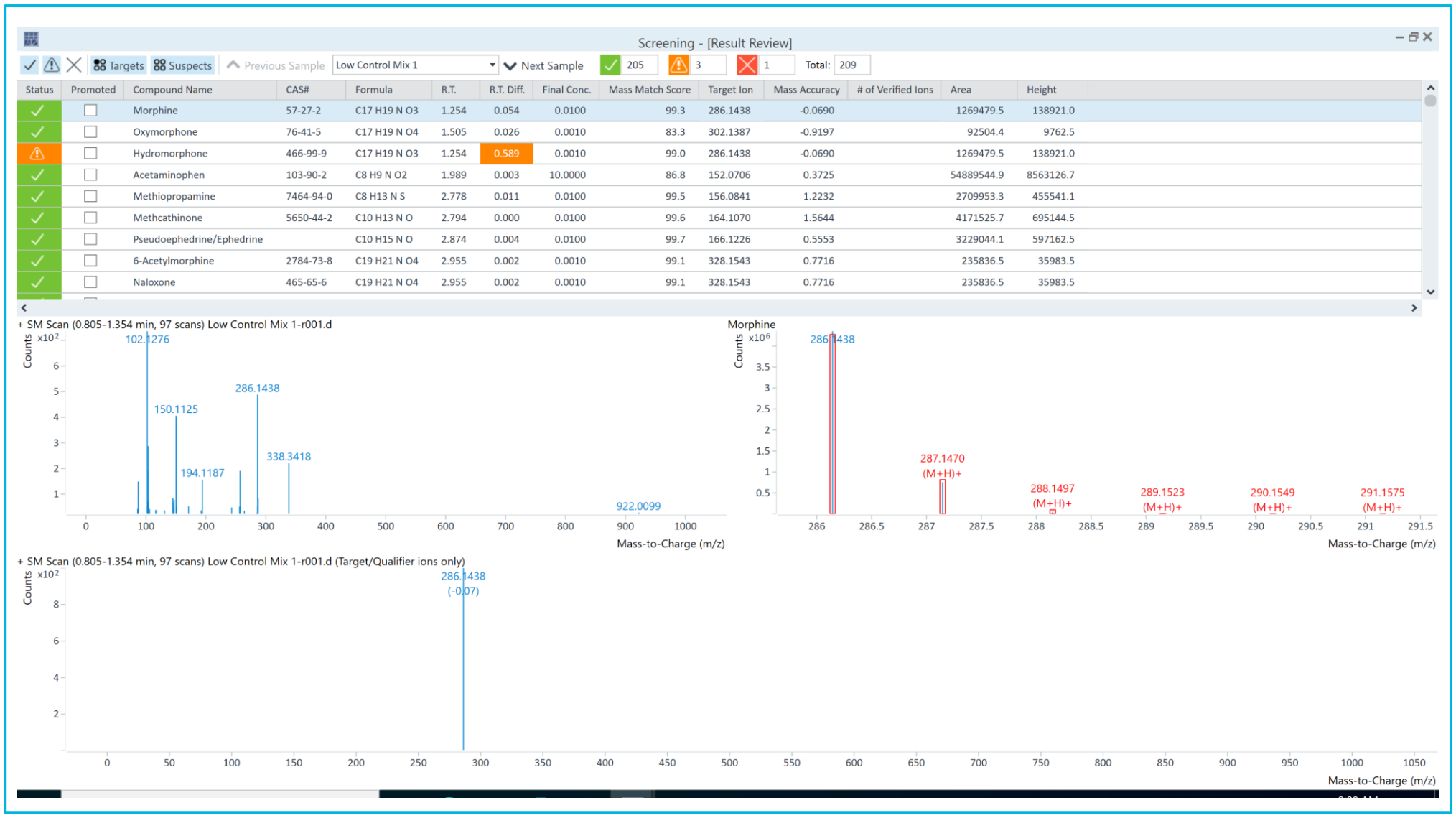


Figure 1. Screener Tool Graphical User Interface.

Mass Match Score %.

The Mass Match Score in Table 1 is derived from the contributions of three scoring elements:

- Monoisotopic Mass Accuracy Score (50%)
- Isotope Spacing Score (25%)
- Isotope Abundance Score compared with Theoretical (25%)
    - Retention time Delta window also used for Identification.
    - Coelution Score available when using All Ions mode of acquisition.

References

1/ Karen E. Yannell,, and Manuel Gomez, Agilent Technologies, Inc., Pub 5994-1744EN

Conclusions

- It has been shown that Comprehensive and large panels of Targets and Suspects can be accurately and reliably screened using SureMass Data Mining combined with the Agilent 6546 Q-TOF LC/MS.
- Mass match Scores are consistently in the high 90% ranges for high and low concentration replicate injections. .
- Mass Accuracy measurements for very high and very low concentration ranges within target classes are consistently below 5 ppm.
- Fast data processing speed for SureMass converted data files of large target and Suspect lists.
- Easy and intuitive Screener Tool for fast data review.
- MS-only and All Ions data formats compatible and reliable.

Mass Accuracy Results for 200+ Target Mixes.

- Of the 200+ Targets and Suspects analyzed as part of this proof of principle study, the vast majority exhibited a Mass Match Score of High 90% values for Low and High Concentration Controls (Averaged over 10x different batches.)
- Mass Accuracy measurements were less than 5ppm for All Targets at low and high concentrations.
- MS-only data results are illustrated due to space constraints, however All Ions data yielded comparable results.

Compound		Low Controls N=10		High Controls N=10	
Name	Transition	Mass Accuracy Average (ppm)	Mass Match Score Average	Mass Accuracy Average (ppm)	Mass Match Score Average
25B-NBOMe	380.0856	0.7303	99.4506	0.5289	99.0208
25C-NBOMe	336.1361	0.9524	98.8240	1.2707	97.6275
25H-NBOMe	302.1751	0.9877	99.5339	0.7183	99.4547
25I-NBF	416.0517	0.9026	99.5882	0.8628	99.5358
25I-NBMD	442.0510	0.8085	99.5329	0.3036	99.6687
25I-NBOH	414.0561	0.9066	99.4942	0.5042	99.5230
25I-NBOMe	428.0717	0.9317	99.5551	0.4652	99.4947
2-MAPB	190.1226	1.0261	99.6256	1.5285	99.3207
3-Chloroethcathinone	212.0836	1.9641	99.4559	1.1749	99.4396
3-Chloromethcathinone	198.0680	1.5290	99.5521	1.4755	98.7582
3-Fluorofentanyl	355.2180	0.4399	99.5225	0.4362	95.1465
3-Fluorophenmetrazine	196.1132	1.6006	99.4387	1.0015	99.5006
4/5-APDB	178.1226	1.1267	99.6459	1.0252	97.9841
4-Chloro-Alpha-PVP	266.1306	1.4243	98.4546	0.8829	99.0547
4-Chloromethcathinone	198.0680	1.5290	99.5521	1.4755	98.7582
4-Methoxybutyrylfentanyl	381.2537	0.1689	99.3459	0.9730	97.9662
5-DBFPV	274.1802	1.1097	99.4470	1.0646	99.1194
5-Fluoro-PB-22	377.1660	1.3315	98.9360	1.1144	98.9819
6/5-MAPB	190.1226	1.0261	99.6256	1.5285	99.3207
6-Acetylmorphine	328.1543	0.4403	98.8440	0.7928	96.4197
7/4/3-MAPB	190.1226	1.0261	99.6256	1.5285	99.3207
7-Aminoclonazepam	286.0742	1.1568	99.3415	0.8375	98.9995
7-Aminoflunitrazepam	284.1194	2.0733	79.7982	0.6751	99.0319
7-APDB	178.1226	1.1267	99.6459	1.0252	97.9841
AB-PINACA	331.2129	1.2961	98.7074	0.3699	98.9559
Acetaminophen	152.0706	1.3173	96.1147	-0.0152	95.2489
Acetylcodeine	342.1700	1.2909	99.3449	0.7533	99.2765
Acetylfentanyl/Benzylfentanyl	323.2118	-0.2557	86.9129	-0.3048	76.5476
Acrylfentanyl	335.2118	0.0969	99.3141	0.6229	95.0780
AH-7921	329.1182	0.3177	99.4097	0.6871	97.5881
alpha-Hydroxyalprazolam	325.0851	0.3184	99.1008	0.2475	95.9373
alpha-Hydroxymidazolam	342.0804	0.9431	99.3600	0.6245	98.4171
alpha-Hydroxytriazolam	359.0461	0.3155	99.5744	0.3510	98.6131
alpha-Methylacetylfentanyl	337.2274	1.0205	99.3151	0.7602	93.4747
alpha-Methylbutyrylfentanyl	365.2587	0.4324	99.6015	1.0453	97.2639
alpha-Methylfentanyl	351.2431	0.3290	99.7223	0.6991	98.7657
alpha-Methylthiofentanyl	357.1995	0.4682	95.2031	0.8197	87.9848
alpha-PVP	232.1696	2.5272	98.4295	0.6026	98.7350
Alprazolam	309.0902	0.8933	99.4558	0.4208	99.1752
Amantadine	152.1434	0.9194	99.7589	0.4772	98.3491
Amitriptyline	278.1903	0.9830	99.5747	0.8207	99.5786
Amoxapine	314.1055	-0.2683	99.1872	-1.6177	96.2973
Amphetamine	136.1121	0.6967	99.7644	1.2288	99.3957
Atomoxetine	256.1696	1.3800	99.0820	0.7558	99.2106
Benocyclidine (BTCP)	300.1780	1.2402	96.8765	1.3403	96.4169
Benzodioxolefentanyl	429.2173	-0.1015	99.8230	0.4187	98.2064
Benzoylecgonine	290.1387	1.4494	99.0252	1.0271	96.4646
Benztropine	308.2009	0.7651	99.5661	0.6244	99.5250
beta-Hydroxyfentanyl	353.2223	0.2969	98.6097	0.9426	98.3199
beta-Hydroxythiofentanyl	359.1788	0.3147	95.9565	0.5345	91.8893
Bromphenіramine	319.0804	0.5644	94.2589	0.6758	99.3564
Bupivacaine	289.2274	1.1032	99.4875	0.7464	99.6823
Buprenorphine	468.3108	-0.1996	98.6039	0.4300	95.7811
Bupropion	240.1150	0.9645	99.4560	0.5109	98.3737
Buspirone	386.2551	1.3212	94.8839	0.7919	95.0845
Butyrylfentanyl	351.2431	-0.0559	99.1605	0.5723	99.4432
Carbamazepine	237.1022	1.1831	99.4187	1.3417	99.3098
Carfentanil	395.2329	0.2101	99.2474	0.9409	92.0454
Cetirizine	389.1626	1.5910	98.0111	0.7802	97.8271
Chlordiazepoxide	300.0898	1.3581	98.0470	1.2255	98.5859
Chlorpheniramine	275.1310	0.5823	99.7127	0.7041	99.1425
Chlorpromazine	319.1030	1.6810	98.9511	0.9923	98.5398
cis-3-Methylbutyrylfentanyl	365.2587	0.4324	99.6015	1.0453	97.2639
cis-3-Methylthiofentanyl	357.1995	0.4682	95.2031	0.8197	87.9848
Citalopram	325.1711	1.1514	98.9534	0.6463	99.5175
Clomipramine	315.1623	1.3570	98.4549	1.1720	98.2892
Clozapine	327.1371	1.0386	98.9943	0.5687	96.7123
Cocaethylene	318.1700	1.2913	99.3682	0.6681	98.9057
Cocaine	304.1543	1.6622	98.7518	1.0749	99.1163
Codeine	300.1594	1.0750	99.5366	1.0536	99.0615
Crotonylfentanyl	349.2274	0.1884	98.6962	0.6017	97.0149
Cyclobenzaprine	276.1747	1.0516	99.6086	0.7257	99.4621
Cyclopentylfentanyl	377.2587	0.5706	99.5663	0.6944	98.1511
Cyclopropylfentanyl	349.2274	0.1884	98.6962	0.6017	97.0149
Desipramine	267.1856	1.0131	99.5078	0.8047	99.3615
Despropionylfentanyl (4-ANPP)	281.2012	0.7178	99.6724	0.7512	94.8923
Dextromethorphan	272.2009	1.1780	99.2860	1.0161	99.0647
Diazepam	285.0789	1.5970	99.1514	0.9648	99.0689
Dibutylone	236.1281	1.4048	99.3200	1.0344	99.0859
Dicyclomine	310.2741	1.3248	99.2659	1.0877	91.3359
Diltiazem	415.1686	1.1079	94.4260	0.8306	94.5139
Diphenhydramine	256.1696	1.3800	99.0820	0.7558	99.2106
Dothiepin	296.1467	1.3708	96.4452	1.3333	95.5365
Doxepin	280.1696	1.1313	99.3114	0.6946	99.1976
Doxylamine	271.1805	0.3598	99.1915	1.0699	95.5068
Ethylone	222.1124	1.5543	99.4040	1.1032	99.5988
Etizolam	343.0779	1.1031	99.3588	0.6204	97.2503
Etomidate	245.1285	0.9626	99.3296	1.2718	98.7999
Fentanyl	337.2274	1.0205	99.3151	0.7602	93.4747
Flubromazepam	333.0033	0.7857	99.5709	0.9333	99.1542
Flubromazolam	371.0302	0.8992	99.6175	0.6152	99.4268
Fluoxetine	310.1413	1.2770	99.1879	0.8369	98.7707
Flurazepam	388.1586	1.2310	98.1698	0.8404	98.1240
Furanylethylfentanyl	327.2067	0.4312	98.8827	0.4214	75.7546
Furanylfentanyl	375.2067	-0.1323	98.7994	0.7507	96.2590
Gabapentin	172.1332	1.0676	99.4188	1.6176	99.3531
Glutethimide	218.1176	-0.1822	47.5714	0.4274	26.5230
Haloperidol	376.1474	0.0598	98.5199	0.7709	97.2650
Hydrocodone	300.1594	1.0750	99.5366	1.0536	99.0615
Hydromorphone	286.1438	0.1829	86.7967	0.5838	92.0022
Hydroxyzine	375.1834	0.8243	98.7516	0.7452	97.7212
Imipramine	281.2012	1.2185	99.5858	1.0139	99.0606

Compound		Low Controls N=10		High Controls N=10	
Name	Transition	Mass Accuracy Average (ppm)	Mass Match Score Average	Mass Accuracy Average (ppm)	Mass Match Score Average
Isobutyrylfentanyl/beta-Methylfentanyl	351.2431	0.0865	99.1605	0.7147	99.4432
Ketamine	238.0993	1.3008	99.2295	1.3093	98.9875
Lacosamide	251.1390	1.4773	99.1081	1.4790	99.2036
Lamotrigine	256.0151	0.5244	98.1497	1.2585	98.1517
Lidocaine	235.1805	0.9896	99.2873	0.8662	95.3565
Loperamide	477.2303	1.4817	95.4532	0.6926	96.0532
Loratadine	383.1521	1.5419	96.2688	1.0261	97.7322
Loxapine	328.1211	1.1375	99.1810	0.7724	98.6391
LSD	324.2070	-0.1899	91.0280	1.2810	83.8689
Maprotiline	278.1903	1.4441	98.9089	0.8646	99.3495
MDA	180.1019	1.4183	99.5409	1.4508	99.5028
MDEA	208.1332	1.5558	99.3208	1.5388	98.9703
MDMA/Methedrone	194.1176	1.4041	98.8112	1.3169	96.5051
MDPV	276.1594	1.1180	99.6175	0.8843	99.5324
Meperidine	248.1645	1.4982	99.4144	1.0344	99.2055
Mephedrone/6-APDB	178.1226	1.1267	99.6459	1.0252	97.9841
Mepivacaine	247.1805	1.4236	99.3452	0.9966	99.5207
Methadone	310.2165	1.1909	99.6076	0.0431	98.5935
Methamphetamine	150.1277	1.5506	99.6178	1.3213	99.5427
Methcathinone	164.1070	1.1943	99.6563	0.9424	99.5560
Methiopropamine	156.0841	1.0051	99.4840	0.9507	99.0218
Methoxetamine	248.1645	1.6191	99.4144	1.1553	99.2055
Methoxyacetylfentanyl	353.2224	0.0704	98.6097	0.7161	98.3199
Methoxyphenidine	296.2009	1.1864	99.5226	1.0278	99.0897
Methylone	208.0968	1.1695	99.2013	1.1699	99.2699
Methylphenidate	234.1489	0.9005	99.5964	0.3965	99.0849
Metoclopramide	300.1473	1.5702	99.0772	0.9129	99.0097
Mexedrone	208.1332	1.5558	99.3208	1.5388	98.9703
Midazolam	326.0855	1.0985	99.2322	0.6859	98.9765
Mirtazapine	266.1652	0.8574	99.5545	0.8258	98.9637
Mitragynine	399.2278	1.3999	99.2904	0.8436	99.3310
Modafinil	296.0716	1.0768	97.5970	1.0625	95.8292
Morphine	286.1438	0.2784	99.5352	0.9745	92.9154
Naloxone	328.1543	0.4403	98.8440	0.7928	96.4197
N-Desalkylflurazepam	289.0538	1.1746	99.6046	1.2005	98.9066
Nefazodone	470.2317	1.1216	96.8872	0.7430	97.1506
N-Ethylpentylone/N,N-Dimethylpentylone	250.1437	2.2353	97.0007	1.0438	98.5456
N-Methyl-Norcarfentanil	305.1859	0.3910	99.5332	0.4108	97.5489
Nordiazepam	271.0633	1.1876	99.3032	0.7893	98.9215
Nordoxepin	266.1539	1.4257	98.9884	1.2922	99.0696
Norfluoxetine	296.1257	0.7822	99.5385	0.9228	98.6686
Norketamine	224.0837	1.3322	99.3716	1.2579	99.2282
Normeperidine	234.1489	0.9005	99.5964	0.3965	99.0849
Norpropoxyphene	326.2115	1.0246	99.2507	0.6611	98.1907
Nortriptyline	264.1747	1.0025	99.4706	0.9553	99.3544
Ocfentanil	371.2129	0.4411	99.1990	0.6794	95.8855
Ondansetrone	294.1601	0.9560	99.5904	0.5222	99.4592
Orphenadrine	270.1852	1.4838	99.2224	1.1835	98.8084
ortho-Fluoroacrylfentanyl	353.2024	0.1671	99.7847	0.5610	98.9805
ortho-Fluorofentanyl	355.2180	0.1662	98.5178	0.9839	94.9368
Oxazepam	287.0582	-0.0699	97.9141	0.8636	93.8947
Oxycodone	316.1543	0.8103	99.7328	1.2426	98.7149
Oxymorphone	302.1387	0.0979	85.4136	0.9646	93.8497
para/meta/ortho-Fluorobutyrylfentanyl	369.2337	0.0421	98.5065	0.7074	93.1344
para/meta-Fluorofentanyl	355.2180	0.1662	98.5178	0.9839	94.9368
para/meta-Fluoroisobutyrylfentanyl	369.2337	0.0421	98.5065	0.7270	93.0278
para-Chloroisobutyrylfentanyl	385.2041	0.1884	98.3865	0.4612	96.6365
para-Fluoroacrylfentanyl	353.2024	0.1671	99.7847	0.5610	98.9805
Paroxetine	330.1500	1.1085	99.0307	0.8900	99.1168
PB-22	359.1754	1.9540	98.5461	1.8107	98.3917
PCP	244.2060	1.2132	99.4043	1.0048	99.3979
Pentazocine	286.2165	1.3908	99.4933	1.1017	99.4688
Pentylone	236.1281	1.4895	99.3200	1.1191	99.0859
Phenazepam	350.9716	0.5269	99.2149	1.0192	99.1708
Pheniramine	241.1699	1.0795	99.5354	0.6692	98.9879
Phentermine	150.1277	1.5506	99.6178	1.3213	99.5427
Phenylfentanyl	385.2274	-0.0273	93.8598	0.6260	94.6356
Pregabalin	160.1332	0.5483	99.5620	1.5299	99.4255
Propoxyphene	340.2271	1.2738	99.4069	0.5193	99.0824
Protriptyline	264.1747	1.0025	99.4706	0.9553	99.3544
Pseudoephedrine/Ephedrine	166.1226	1.1219	99.7599	0.7868	99.7075
PV8	260.2009	1.2423	99.4275	1.1393	99.0248
Quetiapine	384.1740	1.0194	95.5122	1.0945	95.3139
Remifentanil	377.2071	0.6801	99.6402	0.9869	97.4755
Risperidone	411.2191	-0.2300	94.9033	0.2532	89.7754
SDB-005	359.1754	1.8704	98.5461	1.7272	98.3917
Sertraline	306.0811	1.0026	99.5621	1.1621	98.3232
Strychnine	335.1754	1.4218	98.7952	1.0414	99.0826
Suvorexant	451.1644	1.3924	97.6641	1.0314	97.1674
Tapentadol	222.1852	1.1988	99.6794	0.7673	99.4947
Tenocyclidine (TCP)	250.1624	0.9556	96.5439	1.2069	96.1611
Terfenadine	472.3210	1.2938	98.8366	1.1623	98.9635
Tetrahydrofuranfentanyl	379.2380	0.3672	99.1858	0.7307	95.9358
Thienylfentanyl	329.1682	0.5707	96.5548	0.8131	94.6680
Thiofentanyl	343.1838	4.7854	71.2676	3.8186	48.3095
Thioridazine	371.1610	1.1494	95.7092	0.8651	95.2626
TH-PVP	286.2165	1.3633	99.1260	1.0182	96.5809
Tramadol	264.1958	0.5049	99.4863	1.2430	99.2633
trans/cis-3-Methylfentanyl	351.2431	0.3290	99.7223	0.6991	98.7657
Trazodone	372.1586	1.0790	98.7043	0.6927	98.6690
Triazolam	343.0512	0.5378	99.7088	0.6876	98.8043
Trimipramine	295.2169	0.8896	99.6587	0.8429	99.3317
U-47700	329.1182	0.1962	99.4097	0.5656	97.5881
U-48800/U-51754	343.1338	-1.1439	94.3184	0.6103	97.5716
U-49900	357.1495	-0.2363	97.7208	-0.8204	87.3065
Valerylfentanyl	365.2587	0.1609	99.6813	0.8742	97.9486
Venlafaxine	278.2115	1.1190	99.5187	0.9930	99.3317
Verapamil	455.2904	1.1732	99.4624	0.5601	99.4733
Zolpidem	308.1757	1.3234	99.3565	0.8688	98.7888
Zopiclone	389.1123	1.5490	98.4639	1.0888	98.1032

Table 1. Mass Accuracy Averaged Results for 200+ Target Mix (Average over 10x batches of Low and High Controls).

https://www.agilent.com/en/promotions/asms

DE32842014

Published in USA, May 31,2023

Agilent
Trusted Answers