Assessing Antidepressant Pharmaceuticals in the Environment through the Development of a Multidimensional Liquid Chromatography-Ion Mobility Spectrometry-Mass Spectrometry Library

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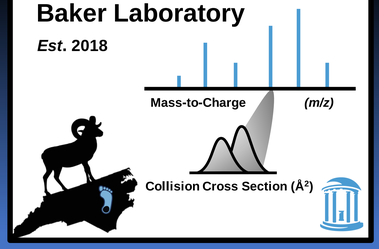
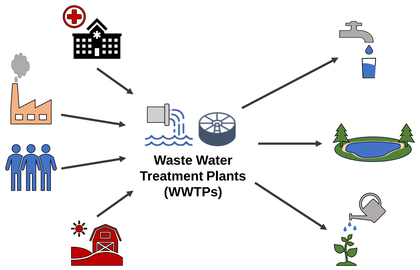
Est. 2018



Antidepressant Background and Emission



- 66% increase in antidepressant dispensing rate (Jan '16 – Dec '22)[1]
- Released to the environment through large-scale runoff and human use
- 30-90% of antidepressants remain unchanged post-metabolism[2]
- Alters behavior and poses a threat to non-target organisms and wildlife

MAOIs — Monoamine Oxidase Inhibitors
Phenelzine (*Nardil*) | Selegiline (*Ensam*)

SSRIs — Selective Serotonin Reuptake Inhibitors
Fluoxetine (*Prozac*) | Sertraline (*Zoloft*)

SNRIs — Serotonin-Norepinephrine Reuptake Inhibitors
Desvenlafaxine (*Pristiq*) | Duloxetine (*Cymbalta*)

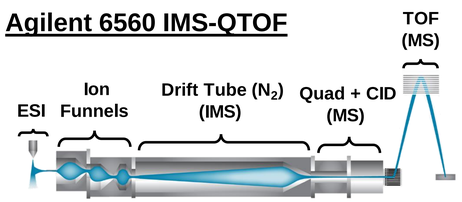
Approval by FDA: 1950 | 1960 | 1970 | 1980 | 1990 | 2000

TCAs — Tricyclic Antidepressants
Imipramine (*Trofranil*) | Amoxapine (*Elavil*)

SDRIs — Serotonin-Dopamine Reuptake Inhibitors
Bupropion (*Wellbutrin*)

Project Goals and Ion Mobility Spectrometry (IMS-MS)

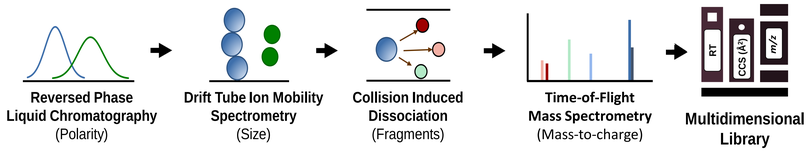
Agilent 6560 IMS-QTOF



Goal: develop a multidimensional library for analysis of complex matrices

- 26 antidepressants
- 5 classes represented
- 5 antidepressant metabolites

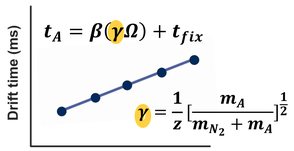
LC-IMS-CID-MS Platform



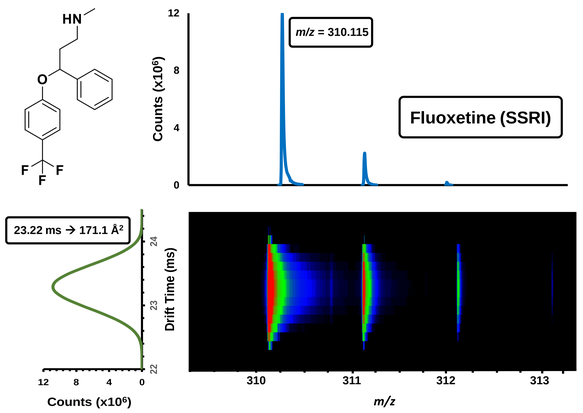
Experimental Workflow

Preparation of Standards → Positive Mode Flow Injection-MS² → Reversed Phase LC-MS² → Cross Section Determination → Library Formation

Single-Field Collision Cross Section (CCS) Method

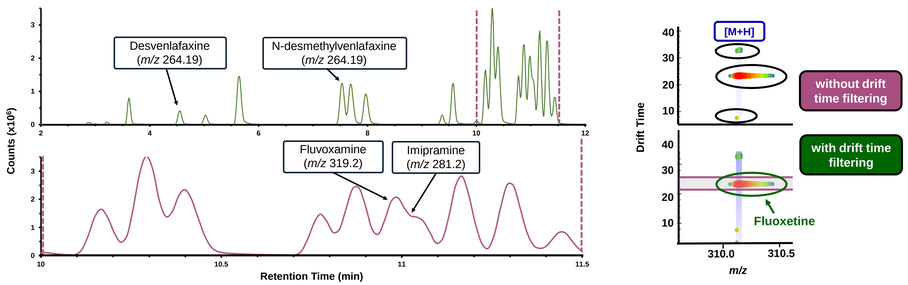


- Relate known CCS to observed arrival times (t_A)
- Use calibration curve to determine CCS values for standards
- Allows for mobility filtering and database matching

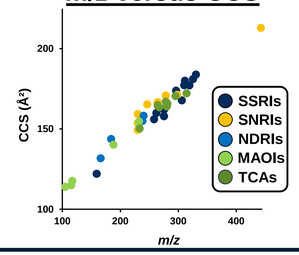


Separation in Three Dimensions

1 Reversed Phase LC (RT) | 2 MS (*m/z*) | 3 IMS (CCS)



m/z versus CCS

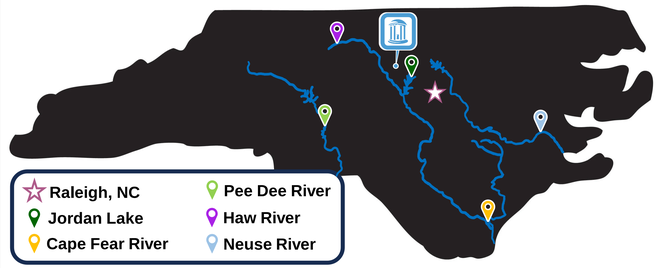


Summary of Results

- *m/z* values, CCS values, and RTs collected for all standards
- CCS values collected in triplicate: <0.25% RSD
- Separation of two constitutional isomer pairs
- Library includes positive mode MS and MS² data

Future Applications

Quantitative Determination of Antidepressants and Metabolites in North Carolina Aquatic Environments



- Use library and LC-IMS-CID-MS platform to measure antidepressants and major metabolites in various environmental matrices
- Possible samples to analyze: surface water near populated cities, wastewater, algae, fish tissue

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1. Argaluza; et al. *World Journal of Psychiatry.* **2021**, 11, 791-804.
2. Chua; et al. *Pediatrics.* **2024**, 153.
3. All chemical structures generated with ChemDraw Professional