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## The Analysis of Commercially Available Kratom Products in Richmond, Virginia

James H. Fleming Jr  
*Virginia Commonwealth University*

Justin Poklis  
*Virginia Commonwealth University*

Michelle R. Peace  
*Virginia Commonwealth University*

Emanuele A. Alves  
*Virginia Commonwealth University*

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### ABSTRACT

Kratom is a novel psychoactive substance that has gained popularity due to its agonism at the  $\mu$ -opioid receptor. Twenty-nine commercially available products were analyzed by Inductively Coupled Plasma/Optical Emission Spectroscopy (ICP/OES) for an inorganic profile and Direct Analysis in Real Time-Mass Spectrometry (DART-MS) for a qualitative, organic profile. Three kratom samples were found to have manganese levels higher than the tolerable upper intake of 11 mg/day. One non-kratom sample was analyzed and found to have phenibut present.

### INTRODUCTION

Kratom, derived from the *Mitragyna speciosa* tree, is an emerging substance of concern. Among 40 indole alkaloids in kratom are mitragynine and 7-hydroxymitragynine, which are partial agonists at the  $\mu$ -opioid receptor<sup>1</sup>. A multitude of kratom products exist in the market, including powders, teas, extracts/isolates, capsules, and even carbonated beverages. The legality of kratom varies from jurisdiction to jurisdiction with no federal regulations<sup>2</sup>. In states where kratom is legal, products can be purchased in tobacco/smoke shops, on the Internet, and in convenience stores. Due to this, the kratom industry remains to be an ambiguous “gray market” with minimal quality control of products released into the market. A total of 29 kratom samples were purchased for this project in the Richmond, Virginia area including 9 powders, 2 capsules, 12 extracts/isolates, 5 teas, and 1 carbonated beverage. All samples were subjected to ICP/OES and DART-MS analysis.



*Mitragyna speciosa* Tree

Kratom Samples



### EXPERIMENTAL



**ICP-OES Analysis.** All powder samples were subjected to an acid digestion prior to analysis. ICP/OES was operated in radial mode for the presence of Al, As, Cu, Fe, Mg, Mn, Ni, and Pb. Y was used as the internal standard. Linearity was achieved with  $R^2 > 0.9980$  for all analytes. **DART-MS Analysis.** The DART-MS was operated in positive mode. Powder samples were subjected to an overnight methanol extraction. All samples were wanded in front of the helium stream six times.



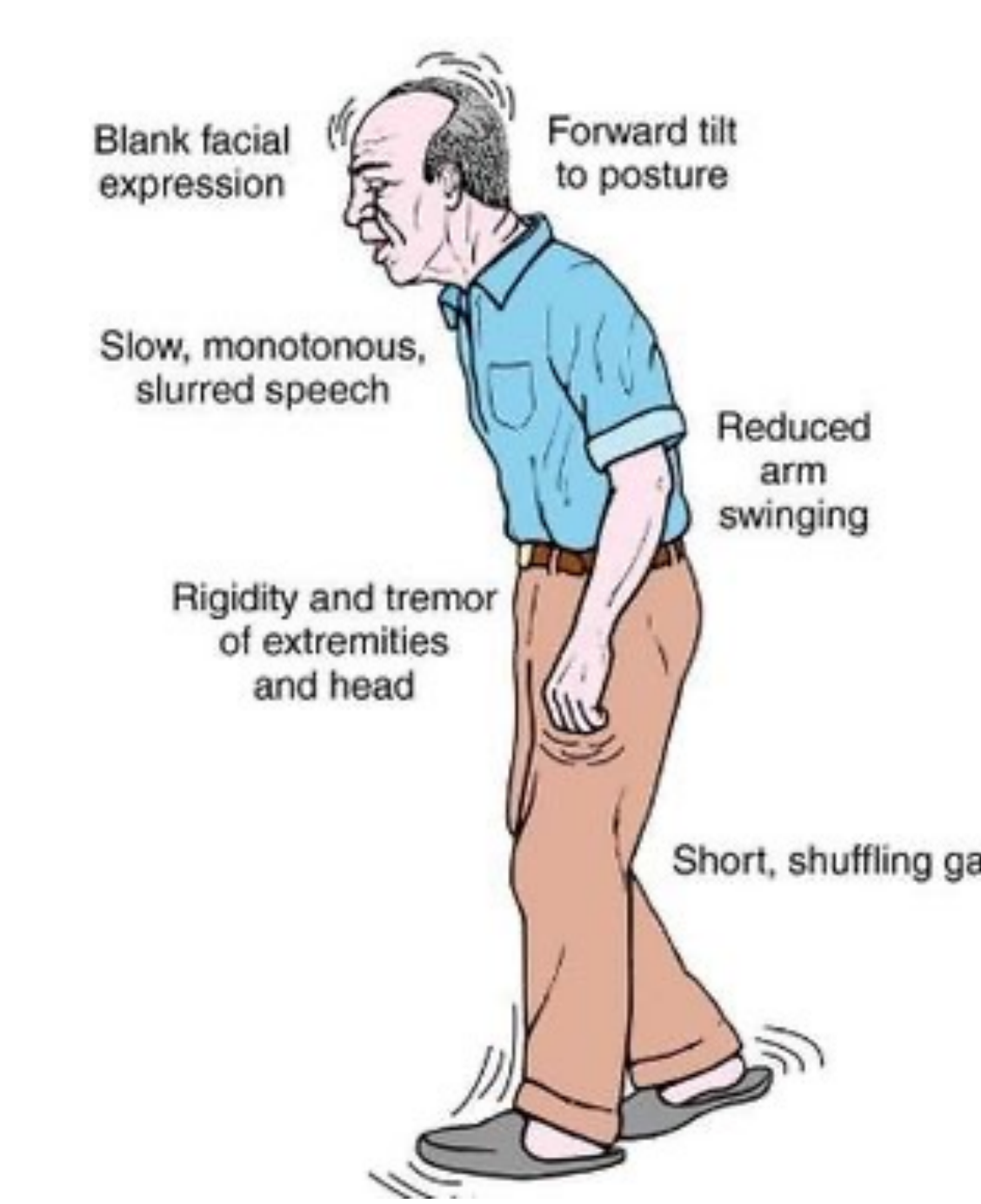
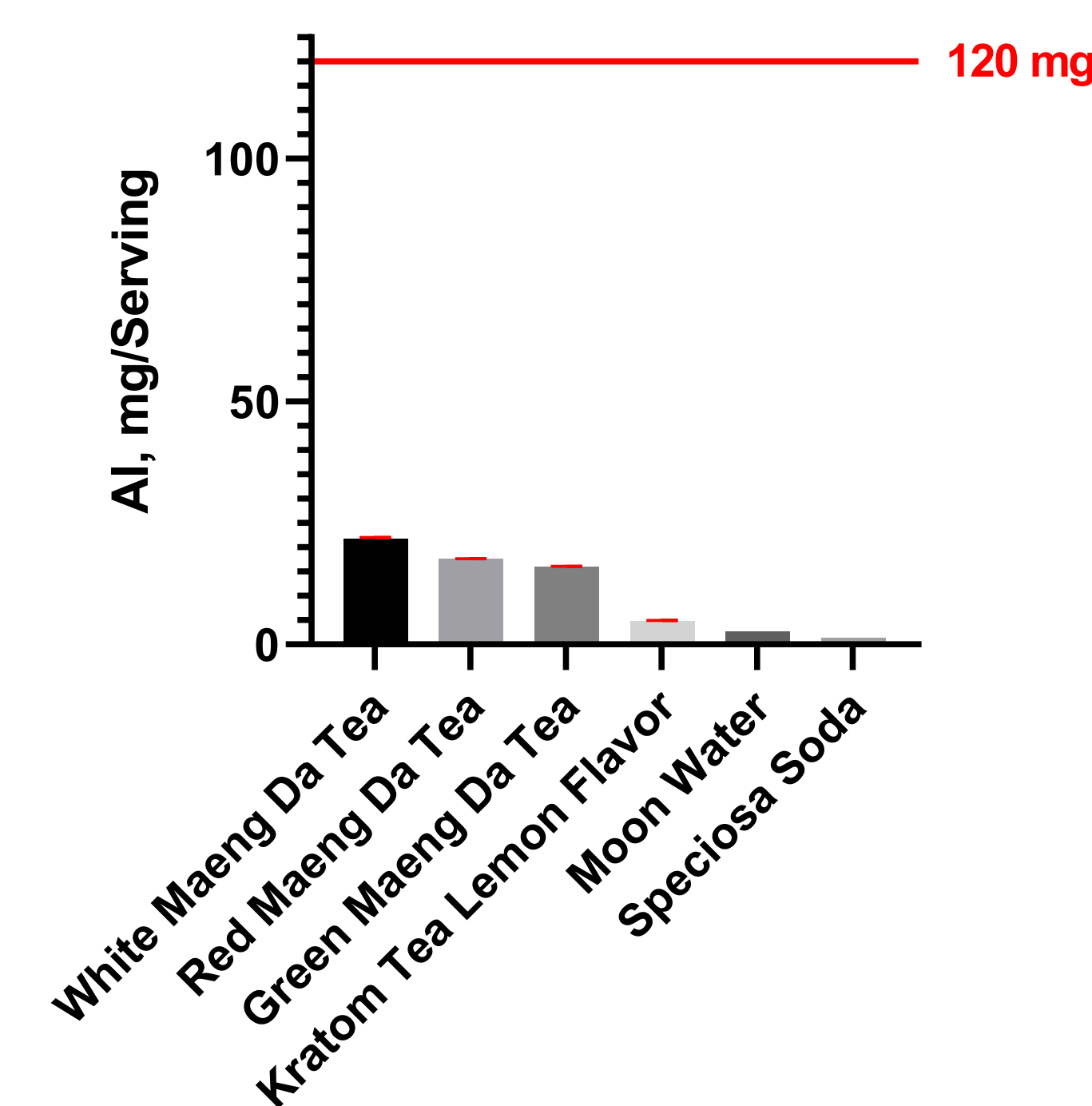
1 g of Kratom Powder



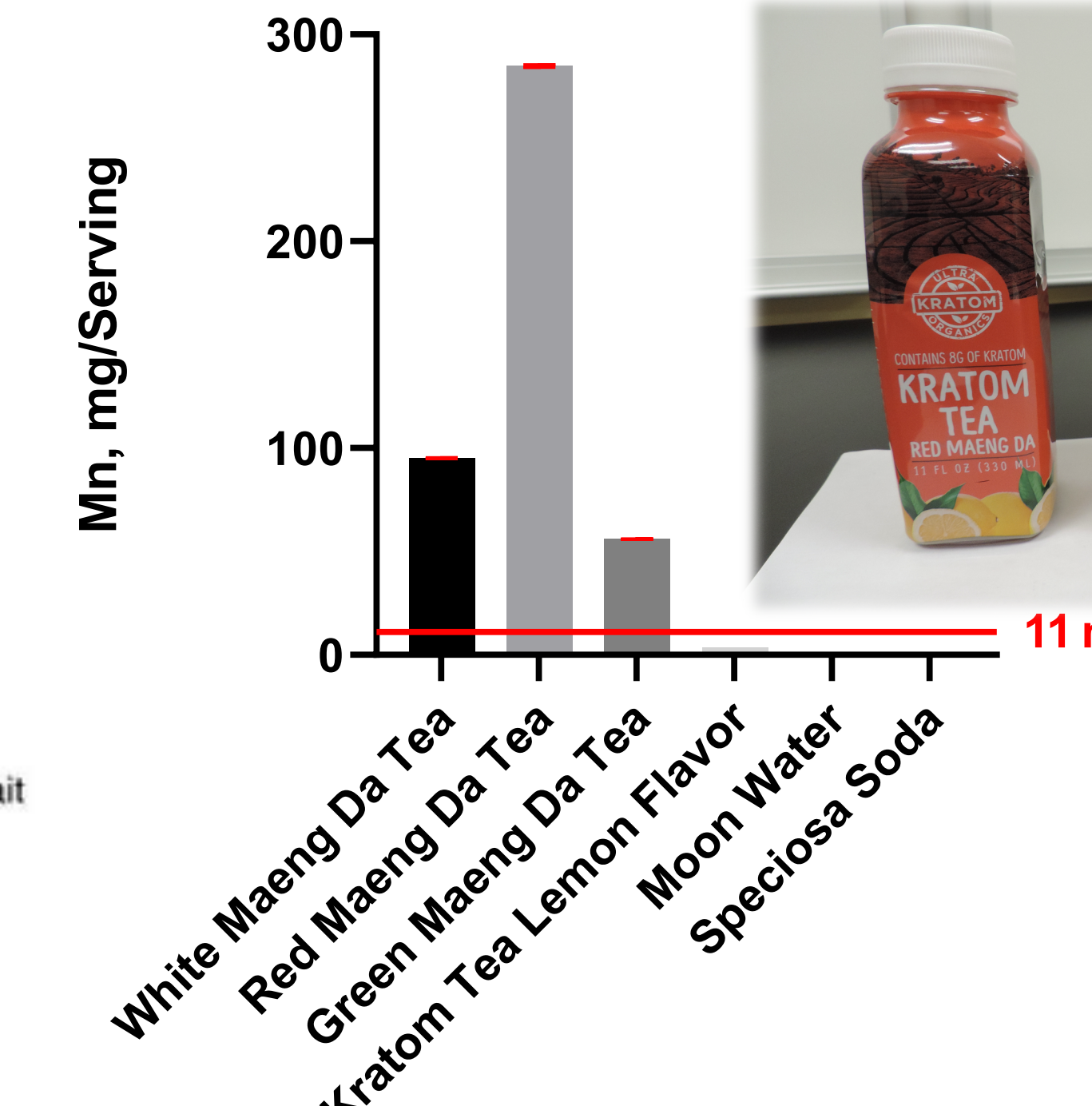
Acid Digestion + Filtration

### RESULTS

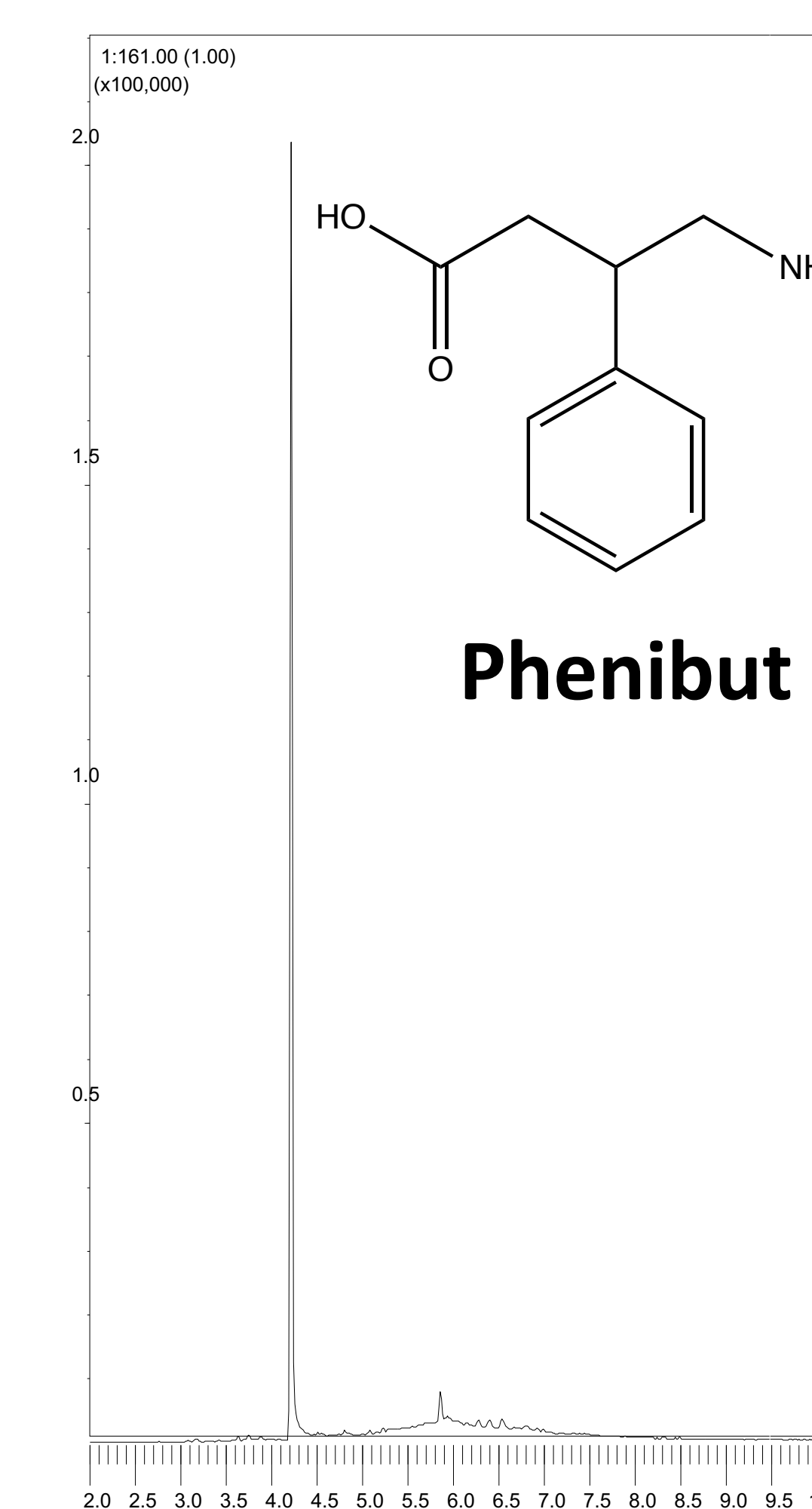
#### Intake of Al in Tea & Soda Samples Based on Suggested Serving



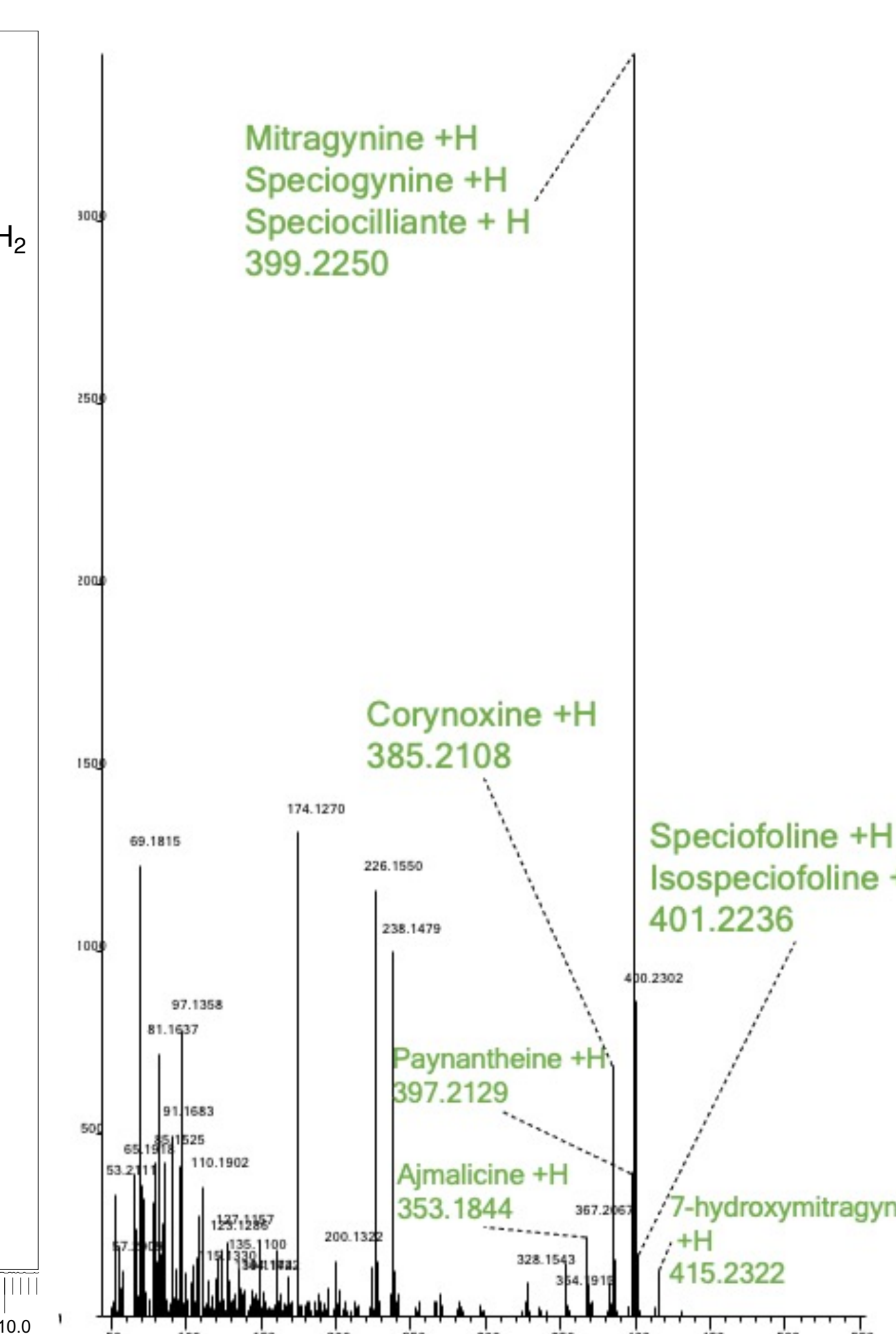
#### Intake of Mn in Tea & Soda Samples Based on Suggested Serving



#### GC-MS Chromatogram



#### DART-MS Spectrum



### DISCUSSION

Three samples were found to have manganese levels exceeding the tolerable upper intake level of 11 mg/day. These samples were produced by the same manufacturer and purchased in the same tobacco store, highlighting the need for stricter quality control and regulation within the kratom industry. Overexposure to manganese can lead to “manganism”, which produces Parkinsonian symptoms including dystonia, tremors, and facial muscle spasms<sup>3</sup>. All kratom samples were found to have main alkaloids mitragynine and 7-hydroxymitragynine via DART-MS analysis. One non-kratom sample was analyzed and found to have phenibut, a nootropic, anxiolytic and GABA-mimetic substance that is a GABA<sub>B</sub> agonist.

### CONCLUSION

In conclusion, this work highlights the need for proper regulation within the kratom industry. A full chemical profile of kratom products will help elucidate potential drug-drug interactions as well as help users know what they are consuming. This work will assist lawmakers in making future decisions regarding the legality of kratom as well as inform kratom users about the products they are consuming.

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