

From Booze to Mobile Phase: Ethanol Leads the Way to a Chemical Free HPLC

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Introduction

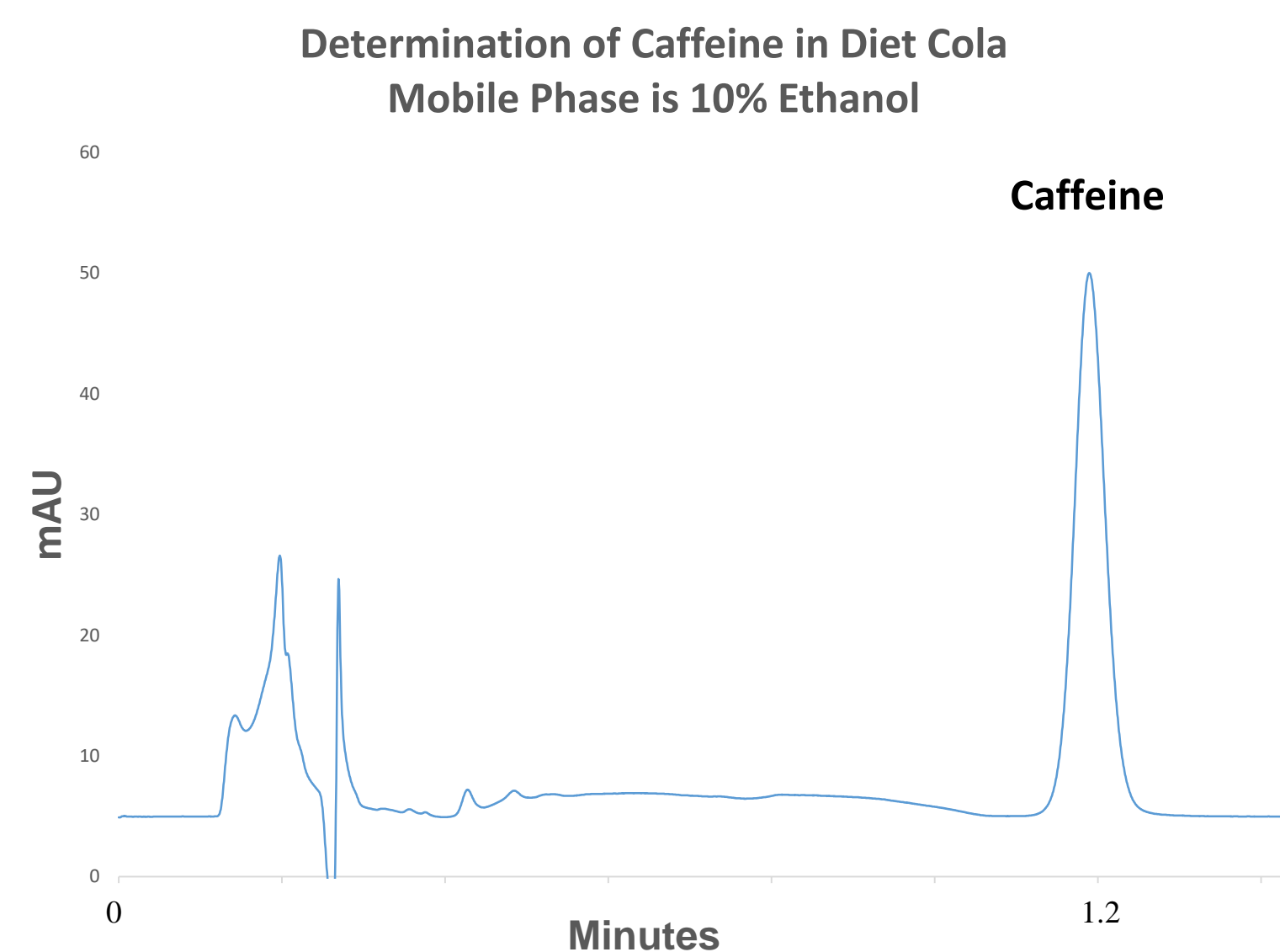
High Performance Liquid Chromatography (HPLC) is one of the most widely used analytical techniques in the world. Unfortunately, its operation almost always involves the use of hazardous solvents. In this paper, we investigate the use of food grade ethanol as an alternative mobile phase in reversed phase HPLC. Ethanol is renewable, non-toxic, and environmentally benign, especially when compared to the predominant mobile phases in use today like methanol and acetonitrile (methyl cyanide). Ethanol mobile phase will also facilitate the use of HPLC in chemical-free environments, such as schools and seminar facilities. Environmentally friendly is one thing, but does ethanol work as a mobile phase? In order to properly answer that question, we had to develop criteria for judging mobile phase usefulness or "goodness." We measured the column pressure in order to determine the relative viscosities and the UV absorption in order to determine the UV cutoffs. We also measured some chemical properties including the selectivity (α) in order to determine if the three solvents have differing chemistries and the retention factor (k) to determine their relative strengths as reversed phase solvents.

Experimental Conditions and Materials

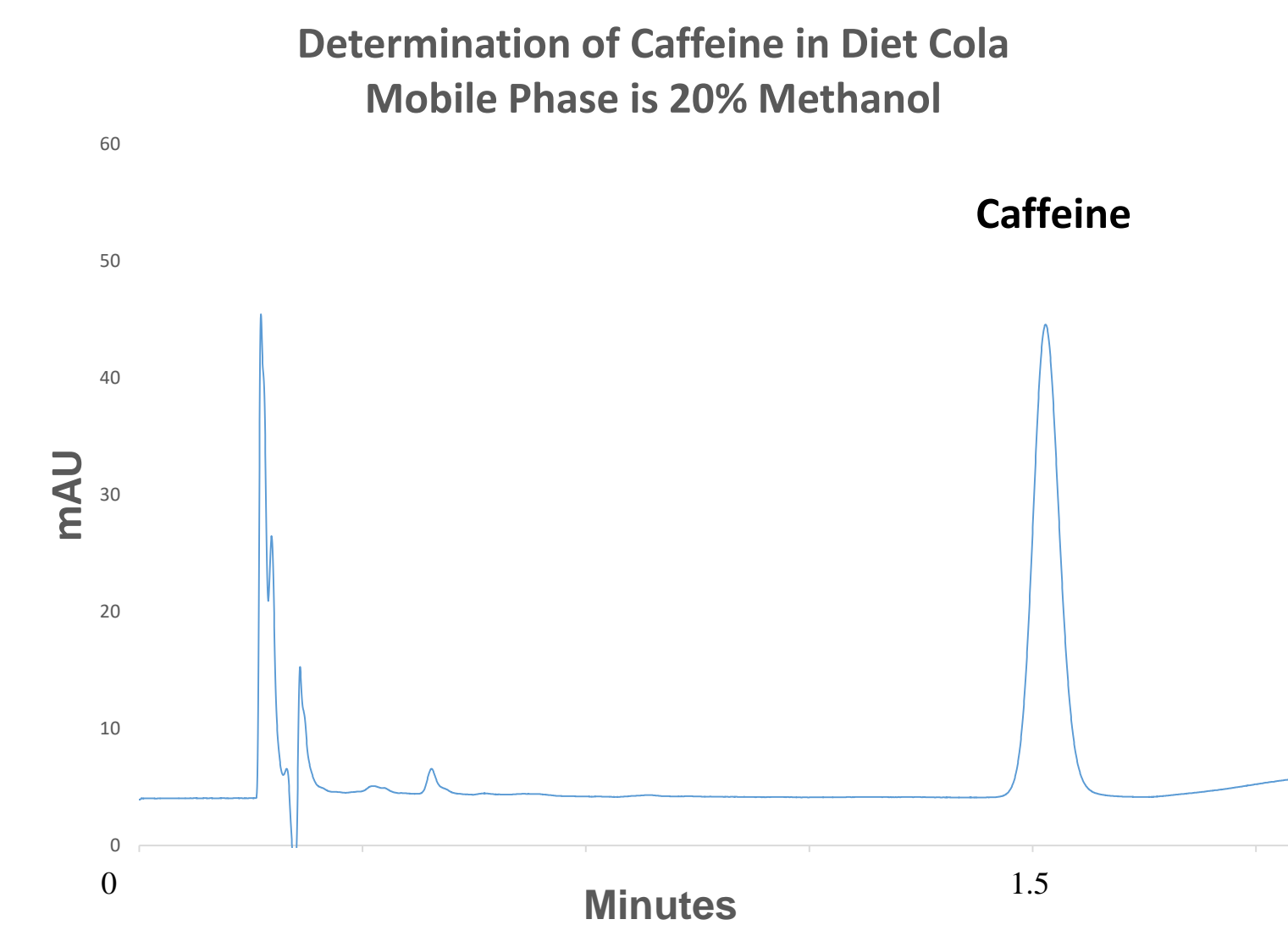
Agilent 1200 SL HPLC system from Agilent Technologies
Binary Pump set at 2.0 mL/min
High Performance Autosampler (G1367C) with a 5 μ L injection
Column compartment set a 40°C
Diode array detector set to 254nm with a 360 nm reference
Column: Zorbax Eclipse Plus C18: 50mm x 4.6 mm x 1.8 μ m + 3.5 μ m
Methanol and Acetonitrile from Honeywell
200 proof Ethanol from Sigma Aldrich
Vodka from Skyy® Vodka
Cellulosic Ethanol from Sweetwater Energy (non-GMO)

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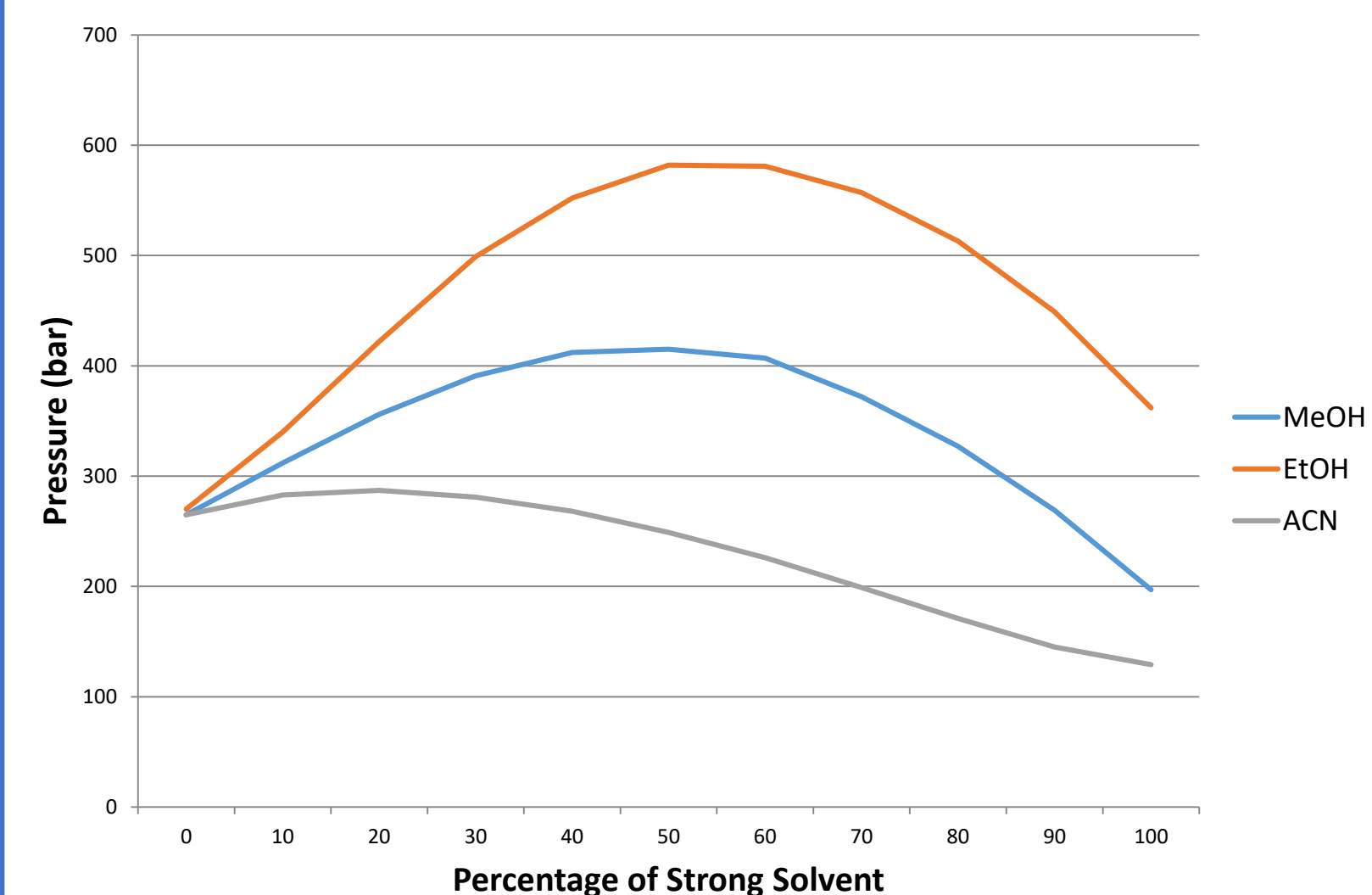
Ethanol Mobile Phase



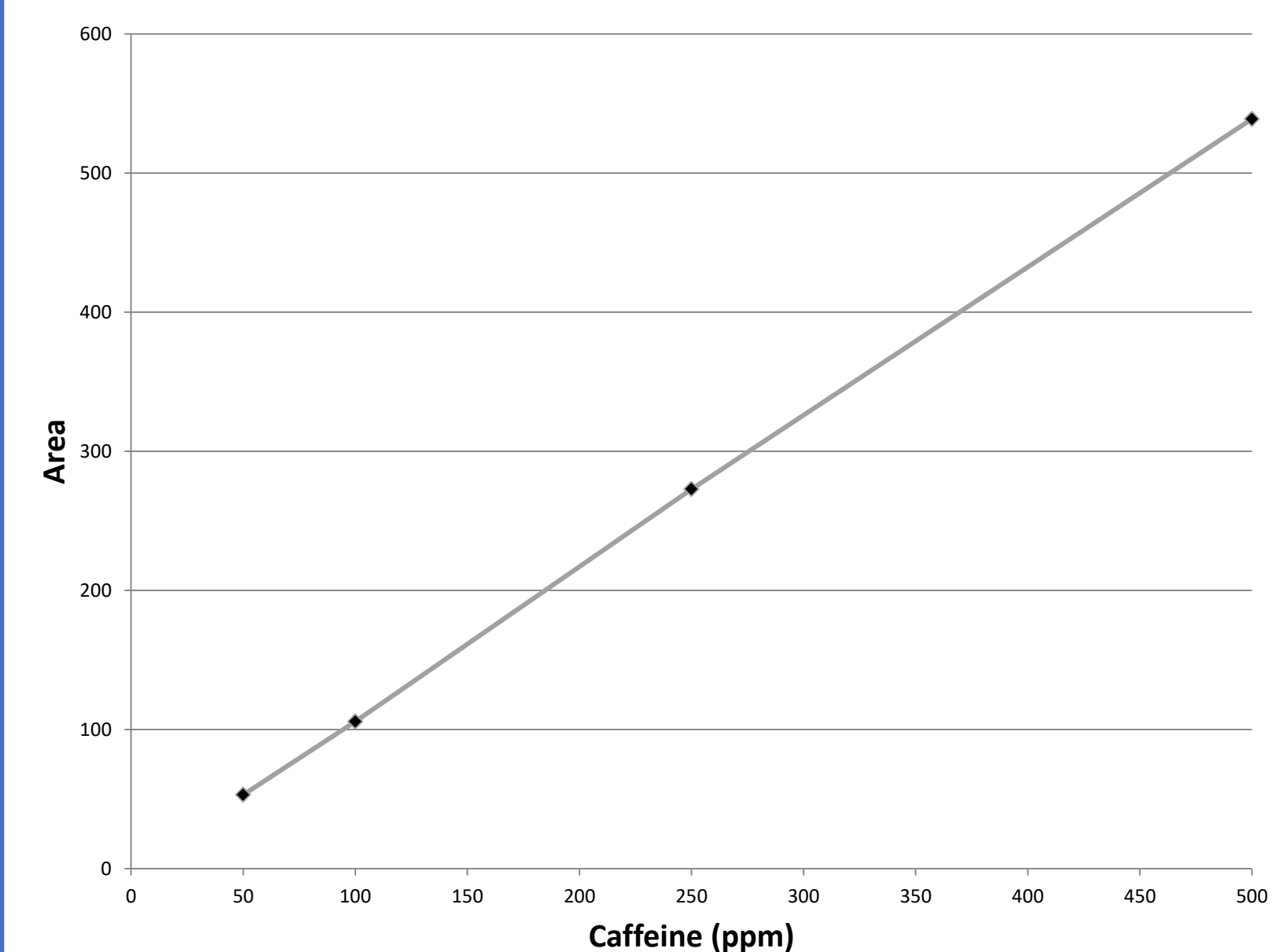
Methanol Mobile Phase



Mobile Phase Viscosity



Caffeine Calibration with Ethanol Mobile Phase



Food Grade HPLC



Conclusions

Food grade ethanol is a viable mobile phase for HPLC analyses, producing comparable results to both acetonitrile and methanol.

Advantages

- Ethanol is non-toxic and readily available, reducing the exposure hazard as well as the disposal issues.
- Ethanol seems to be a stronger mobile phase in the reversed phase mode, requiring less organic solvent.
- Ethanol yielded similar results to the traditional methanol and acetonitrile mobile phases.

Disadvantages

- Ethanol is higher viscosity than both methanol and acetonitrile, leading to higher pressures. This pressure issue can be mitigated through the use of elevated temperatures.

Acknowledgements

We would like to thank Agilent Technologies for providing some of the equipment and columns, and Axion Analytical Labs for use of the facility and direction.