Initial investigation of select pesticides present in wildflower honey using headspace solid-phase microextraction coupled with gas chromatography-mass spectrometry

Maura Bramlitt, Dr. Drew Budner

Coastal Carolina University Department of Chemistry

Background

Wildflower honey is classified for its variety in nectar source, rather than coming from one specific botanical nectar. Flavor will vary depending on season and location as geographical and environmental conditions are different for each honey.[1]

According to the EPA the acceptable limits in honey for Coumaphos is 0.1 ug/g, for Amitraz is 0.2 ug/g, and for 2-4-Dimethylanaline is 0.2 ug/g.[2]

Pesticides can enter honey in two main ways; direct treatment of the hive and by the bees collecting nectar from treated plants which results in the pesticides being brought back to the hive.[3] Some pesticides have been known to have negative effects on the body such as being carcinogenic or suppressing the central nervous system. Additionally, many pesticides decrease hive productivity and can lead to death of the bees and demise of the entire hive.[3] This is important because honey is a major part of the food economy and bees are important pollinators for our agriculture.

Materials and methods

Materials:

Three wildflower honeys were analyzed. The Simply Nature Brazilian wildflower honey was purchased from Aldi in Conway SC. The Mountain man honey was purchased in Conway SC. And the David Grissett honey was purchased in Ocean Isle NC.

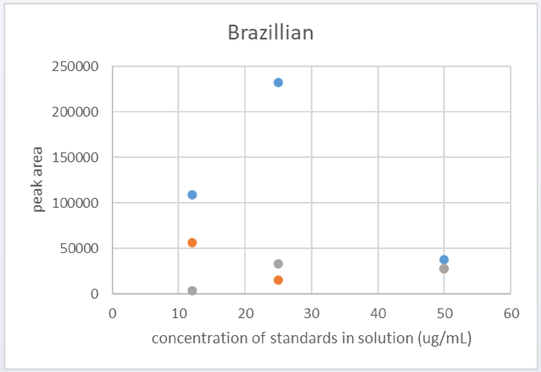
Standards of the pesticides used were Amitraz, Coumaphos, and 2-4-Dimethylaniline.

Methods:

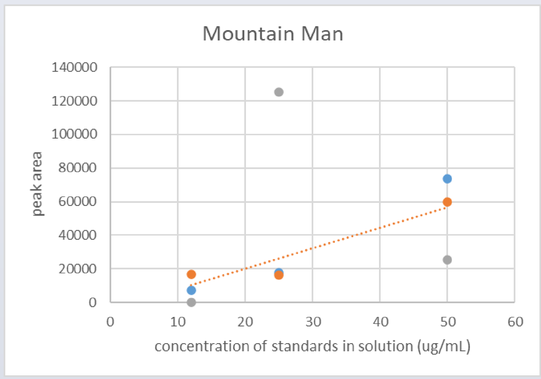
Honey (0.5g), water (10 mL), Coumaphos (1 µg mL^{-1}), Amitraz (1 µg mL^{-1}), and 2-4-Dimethylaniline (1 µg mL^{-1}), was added to 15 mL vial. SPME fiber was suspended within vial for 60 minutes with agitation at room temperature. Fiber was thermally desorbed into in a Shimadzu QP 2010 SE GCMS.

Methods were modeled from the Volante et al. experiment.[4]

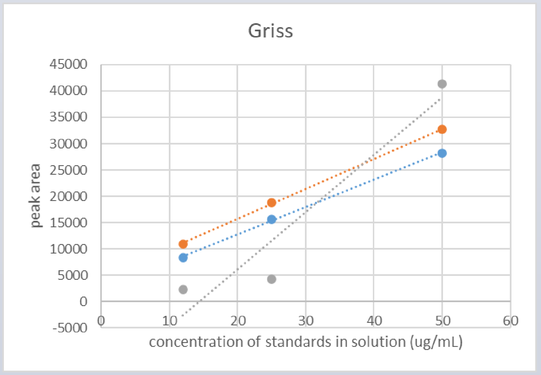
Data



Standard addition calibration curve showing the relationship between the concentration of amitraz (grey), coumaphos (orange) and 2,4-Dimethylaniline (blue) and the peak area for the Simply Nature Brazilian honey.



Standard addition calibration curve showing the relationship between the concentration of amitraz (grey), coumaphos (orange) and 2,4-Dimethylaniline (blue) and the peak area for the Mountain man honey.



Standard addition calibration curve showing the relationship between the concentration of amitraz (grey), coumaphos (orange) and 2,4-Dimethylaniline (blue) and the peak area for the David Grissett honey.

Results

Concentrations of each pesticide for Simply Nature Brazilian honey

Pesticide	Concentration (ug/g)
Amitraz	Below the limit of detection
2,4-Dimethylaniline	Below the limit of detection
Coumaphos	Below the limit of detection

Concentrations of each pesticide for Mountain Man honey

Pesticide	Concentration (ug/g)
Amitraz	Below the limit of detection
2,4-Dimethylaniline	Below the limit of detection
Coumaphos	69.41

Concentrations of each pesticide for David Grissett honey.

Pesticide	Concentration (ug/g)
Amitraz	287.20
2,4-Dimethylaniline	88.84
Coumaphos	149.09

Discussion

The concentrations of amitraz, coumaphos, and 2,4-Dimethylaniline in the Brazilian honey were all below the limit of detection for the system. This is reasonable because the honey was advertised as organic.

In the mountain man honey, the concentrations of amitraz and 2,4-Dimethylaniline were below the limit of detection for the system. The concentration of coumaphos was found to be 69.41 ug/g of honey.

In the Griss honey, the concentrations of all three pesticides were able to be detected. The concentration of amitraz was calculated to be 287.20 ug/g, the concentration of 2,4-Dimethylaniline was calculated to be 88.84 ug/g, and the concentration of coumaphos was calculated to be 149.09 ug/g.

The data indicates that operations were done near the limit of detection for the system, this indicates that further optimization of this method is required to gain more reliable data.

Conclusion

Mountian man and David Grissett honeys showed concentrations of amitraz, 2,4-Dimethylaniline, and coumaphos that were above the acceptable limits for honey, 0.2 ug/g, 0.2 ug/g. and 0.1 ug/g respectively. The pesticides could not be detected in the Brazilian honey.

To improve the data analysis, more samples of honey could be analyzed for these pesticides for further comparison. Additionally, increased optimization of the method would increase the accuracy of the results. The honey samples could also be analyzed for pesticides that are more commonly used in the North Carolina- South Carolina region to provide a better analysis of the locally sourced honeys.

References

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3. Sanchez-Bayo, F; Goka, K. Impacts of Pesticides on Honey Bees. In *Beekeeping and Bee Conservation: Advances in Research*; IntechOpen. 2016. 77-98
4. Volante, M.; Galarini, R.; Miano, V.; Cattaneo, M.; Pecorelli, I.; Bianchi, M.; Marinoni, M. T.; Cossignani, L.; Damiani, P. A SPME-GC-MS Approach for Antivarroa and Pesticide Residues Analysis in Honey. *Chromatographia* **2001**, *54* (3-4), 241–246.