# A UK Survey of Honey, Teas and Herbal Supplements for Pyrrolizidine Alkaloids

AUTHORS

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## INTRODUCTION

Pyrrolizidine alkaloids (PAs) are found in many plant families, including *Senecio*, *Eupatorium*, *Symphytum*, *Cynoglossum*, *Heliotropium* and *Crotalaria*. These genera are widely distributed throughout different climates. Each plant species has a characteristic distribution of PAs and a typical ratio of free base to N-oxide.

A survey was commissioned by the UK Food Standards Agency to determine the occurrence of 19 PAs in selected products in the UK. The samples analysed were; 52 *Camelia sinensis* teas (including three fruit flavoured instant teas), 66 herbal teas (including non-*Camelia* instant teas), 45 plant supplement preparations and 54 samples of honey.

## METHODS

Samples were analysed using the BfR methods (1, 2) using SPE clean-up and LC-MS/MS determination. Infusions were made of dried tea samples that were found to contain PAs and these were also analysed.

## RESULTS

The results of the survey are summarised in Table 1. PAs were found in some teas, the highest level was over 50 mg/kg total PAs (echimidine and intermedine) measured in a comfrey tea. Five samples of black tea contained detectable PAs (total PAs up to ca 1 mg/kg, comprising combinations of retrorsine, retrorsine N-oxide, senecionine and senecionine N-oxide). Four out of five rooibos teas contained PAs, the highest level was ca 1 mg/kg total PAs (retrorsine and senecionine compounds).

For honey samples, higher levels of PAs were found in honey from countries with a warmer climate with a relatively high frequency of low level PA contamination of Manuka honeys, and very high levels of borage PAs in honey from bees foraging on borage.

Four plant supplements were also found to contain PAs, the highest level of 343 µg/kg was found in a sample of Marshmallow extract.

| | No. of samples | Concentration range of PAs detected (µg/kg) | | | Max. Total PA concentration (µg/kg) | PAs detected |
|---|---|---|---|---|---|---|
| | | <20 | 21-500 | >500 | | |
| **Tea** (Black, Green, Earl Grey) | 52 | 41 | 10 | 1 | 1170 (Black Tea) | Retrorsine, Retrorsine N-Oxide Senecionine, Senecionine N-Oxide Intermedine, Lycopsamine |
| **Herbal Teas** (Peppermint, fruit, fennel, ginseng, nettle, rooibos, camomile, lemon balm, liquorice, comfrey and mixtures) | 66 | 32 | 22 | 12 | 52500 (comfrey)<br>50250 (mixture) | Intermedine, Lycopsamine, Echimidine<br>Echimidine, Lycopsamine |
| **Plant Dietary Supplements** | 45 | 41 | 4 | 0 | 343 | Echimidine, Intermedine, Lycopsamine, Retrorsine N-Oxide, |
| **Honey** (Blended, Manuka, single floral) | 54 | 40 | 14 | 0 | 250 | Lycopsamine, Intermedine, Heliotrine |

**Table 1.** Summary of Pyrrolizidine Alkaloid Results

## CONCLUSIONS

This survey confirmed that the N-oxide forms were present at higher concentrations than the free base in teas, that certain PAs, notably monocrotaline and its N-oxide were absent, and that lycopsamine, echimidine and senecionine N-oxide were the major contaminating PAs.

The sampling of teas is significant for PA analysis. In this work tea bags from a limited number of packets were mixed well into a composite. Intact tea bags were used in brewing experiments to prepare infusions, and did not correspond to the more homogenous samples used to determine the PA content of the dry tea. Results from the brewing experiments (not shown) highlighted that further studies are required in this area as the PA contamination of individual tea bags was found to be highly variable. This complicates the calculation of consumers' exposure to PAs and suggests that further work is needed to address sampling issues in this area.

## REFERENCES

1. Determination of pyrrolizidine alkaloids (PA) in plant material by SPE-LC-MS/MS Method Protocol BfR-PA-Tea-2.0/2014

2. Determination of pyrrolizidine alkaloids (PA) in honey by SPE LC-MS Method Description BfR-PA-honey-1.0/2013

## ACKNOWLEDGEMENT

This work was funded by the UK Food Standards Agency

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