

# Phenylacetaldehyde in honey – residue or natural compound?

Klaus Beckmann<sup>1</sup>, Gudrun Beckh<sup>1</sup>, Cord Lüllmann<sup>1</sup>  
Karl Speer<sup>2</sup>



<sup>1</sup> Quality Services International GmbH  
Flughafendamm 9a, D-28199 Bremen, Germany  
info@qsi-q3.de

<sup>2</sup> Institute of Food Chemistry, Technische Universität Dresden  
Bergstrasse 66, D-01062 Dresden, Germany  
Karl.Speer@chemie.tu-dresden.de



Stiftung Warentest, in its April issue 2004, rejected some of the honeys tested due to concentrations of phenylacetaldehyde between 1.0 – 2.6 mg/kg<sup>[1]</sup>. Phenylacetaldehyde can be used as a bee repellent to simplify harvesting of honey<sup>[2]</sup>. This substance can also be generated in honey itself from the amino acid phenylalanine, either with the help of enzymes (Fig. 1) or by Strecker degradation<sup>[3]</sup> (Fig. 2).

It follows that, the amounts of phenylalanine are important for the estimation of phenylacetaldehyde contents. Amino acid analyses have shown that the contents of phenylalanine in honeys differ largely and depend on the botanical origin of the honeys (Fig. 3, Tab. 1). These results correspond to the literature<sup>[4-6]</sup>.

Therefore, an accurate method for the analysis of phenylacetaldehyde had to be applied. The suggested headspace GC/MS-method<sup>[2,7]</sup> is not suitable because phenylacetaldehyde is created during the incubation process in the headspace oven. In this research project a recently presented extraction method was used<sup>[8]</sup>. As shown in Fig. 5 on the basis of a phenylalanine-spiked sugar syrup, no phenylacetaldehyde was created when using the extraction method.

In the next step, storage tests were carried out. An acacia honey and a wild flower honey with phenylalanine and phenylacetaldehyde contents shown in Tab. 1 and sugar syrup, pure and spiked with phenylalanine (500 mg/kg), were portioned off and stored in darkness (a) at room temperature (22°C) and (b) at 39°C as well as (c) under UV light at 22°C for up to 14 weeks. The concentration of phenylacetaldehyde in each sample was determined at intervals.

Under (a) the concentrations remained the same, under (b) and (c) the concentrations partially increased considerably, except for those of the pure syrup (Fig. 6).

These results reveal that the findings presented by Stiftung Warentest are not based on a sound scientific method, especially since they completely ignore the phenylalanine contents and the storing conditions of the honeys.

Currently, the possibility of distinguishing between natural phenylacetaldehyde and the residues is being studied with the help of isotope ratio mass spectrometry.

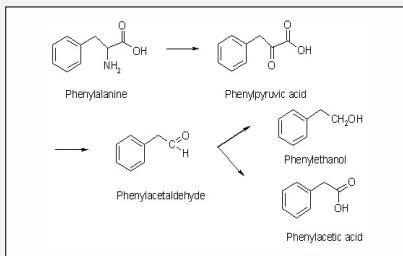


Fig. 1: Build-up mechanism of phenylacetaldehyde by enzymes

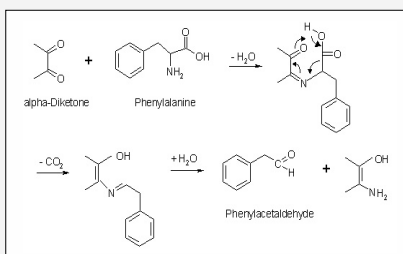


Fig. 2: Build-up mechanism of phenylacetaldehyde by Strecker degradation

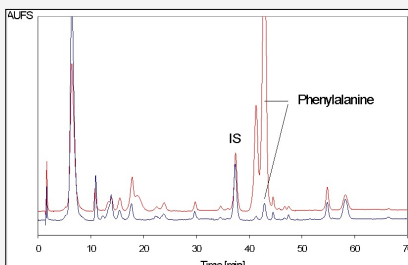


Fig. 3: Amino acid chromatograms of Lavender and Acacia honey

Honey	Phenylalanine [mg/kg]	Phenylacetaldehyde [mg/kg]
Acacia	26.6	0.2
Fir	< 5	0.1
Wild Flower	450	2.0
Lavender	1369	2.7

Tab. 1: Amounts of phenylalanine and phenylacetaldehyde in honey samples of different origin before storage tests

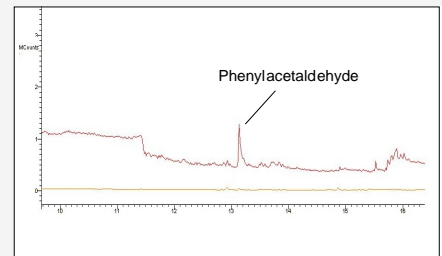


Fig. 5: TIC-chromatograms on an DB 5 column Sugar syrup, spiked with phenylalanine, headspace-method and extraction method

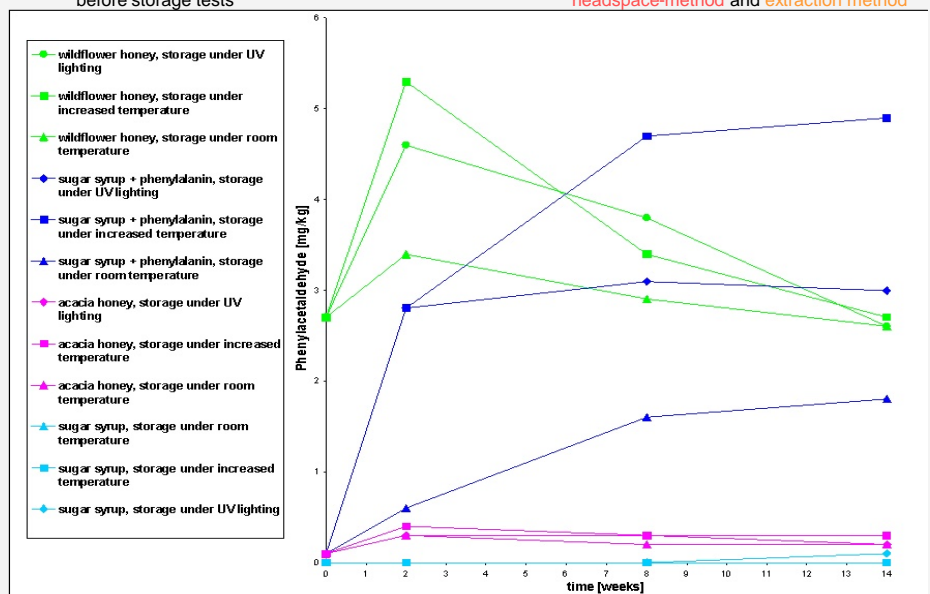


Fig. 6: Results of the storage tests: pure sugar syrup, acacia honey, sugar syrup spiked with phenylalanine and wildflower honey

## References

- [1] Stiftung Warentest 4 (2004), 20-26
- [2] Report No. 26 of Kantonslabor Basel (25/09/2003), 1-2
- [3] Deifel, A. "Die Chemie des Honigs", 23 (1) (1989), 25-33
- [4] Cometto, P. M., Faye, P. F., Naranjo, R. D. Di Paola, Rubio, M. A., Aldao, M. A. J., J. Agric Food Chem, 51 (2003), 5079-5087
- [5] Speer, K., Montag, A., Deutsche Lebensm Rundsch, 82 (1986), 248-253
- [6] Speer, K., Montag, A., Deutsche Lebensm Rundsch, 83 (1987), 103-107
- [7] Bogdanov, S., Kilchenmann, V., Seiler, K., Pfefferli, H., Frey, Th., Roux, B., Wenk, P., Noser, J., J Apicultural Res, 43 (1) (2004), 14-16
- [8] Beckmann, K., Beckh, G., Lüllmann, C., Speer, K., Deutsche Lebensm Rundsch, 103 (4) (2007), 154-158

## Conclusion

1. The content of phenylacetaldehyde depends on the phenylalanine content and on the storing conditions.
2. Levels of 1 – 2.5 mg/kg of phenylacetaldehyde cannot be regarded as residue, unless the phenylalanine content is taken into consideration.