Investigating the transfer of acaricides from beeswax into honey, nectar, bee bread, royal jelly and worker jelly

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Beeswax contamination derive from different sources. A main source are acaricides that are used to control the parasite mite *Varroa destructor.* Since it is common practice to recycle wax, acaricides can accumulate in beeswax due to their fat-soluble properties. While many studies focused on the contamination of wax and honey, the purpose of the current study was to directly compare contamination levels in different types of bee products. Special attention was payed to the food of worker and queen larvae (worker jelly and royal jelly). We investigate the transfer pathways of the active substances and compare the influence of properties of the matrices and substances like the water and fat solubility and retention period. Therefore, beeswax without any detectable pesticide residues was used to pour wax foundations with five different acaricide concentration levels. We used a mix of ten different acaricides that had been most frequently detected in commercial beeswax during preliminary testing. The used initial concentration mirrored field-realistic maximum concentrations. In addition, two lower and two larger concentrations were used as further treatments. The poured foundations were processed into honeycombs by bees. Subsequently, the combs were taken from the hives and honey, nectar, bee bread, royal and worker jelly were manually applied to each treated comb. Combs were incubated at in-hive conditions. The duration ranged from a few days for nectar and larval food up to two months for honey and bee bread, mimicking natural processing conditions in a hive. To evaluate the transfer of residues, samples of all matrices, as well as wax, were taken directly from each comb at the start and the end of the trial. To investigate if the process of comb construction from manually poured foundations may have altered the treatment conditions, additional Petri dishes were filled with round pieces of the spiked original foundations. The same matrices were applied to the Petri dishes and incubated accordingly. Samples were analyzed by Liquid Chromatography-Mass Spectrometry (LC-MS/MS).

The results will help to retrace the transfer of acaricide residues from beeswax into bee relevant matrices by taking the differing chemical properties of the active substances and test matrices into account. Ultimately, our results will help modeling the migration of acaricides within the hive and to estimate a possible exposure of adult honey bees and honey bee larvae.