Organic honey as a real scenario of multiple pesticide contamination

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INTRODUCTION

Bee products, such as honey, are widely consumed as food and consumer interest is currently oriented towards organic foods. The European Commission establishes that the classification of organic honey and other beekeeping products as deriving from organic production is closely tied to the characteristics of hive treatment as well as the quality of the environment. According to the Council Regulation, the use of allopathic chemically-synthesised medicinal products for preventive treatments in organic beekeeping is prohibited, since these fat-soluble and non-volatile compounds can accumulate in the stored honey, where they are able to migrate from the wax comb. Many pollutants in the environment may contaminate bee matrices, comprising bee honey and pollen. Environmental pollutants include pesticides, heavy metals, bacteria and radioactive materials. Agricultural contamination with pesticides is a challenging problem that needs to be fully addressed in the field of organic production systems to assess the incidence of multiresidues of pesticides leading consumers potentially exposed to multiple chemicals, and is thus critical for vulnerable categories such as infants and the elderly.

METHODOLOGY

60 organic honey samples were provided by beekeepers from three different Italian regions characterised by different industrial and agricultural conditions: Calabria, South Italy (14 samples); Trentino-Alto Adige, North Italy (19 samples) and Lombardy, North Italy (27 samples). The extraction method, based on an in-line single step (extraction and purification) using ASE (accelerated solvent extraction) technology, was validated for multiclass residues analysis. Our attention was focused on the residues of pesticides used in citrus and apple orchards for crop protection [organochlorines (OCs) and organophosphates (OPs)] as well as other POPs present in the environment as a possible consequence of anthropic activities [polychlorobiphenyls (PCBs) and polybromodiphenylethers (PBDEs)]. A GC Trace 1310 chromatograph coupled to a TSQ8000 triple quadrupole mass detector (Thermo Fisher Scientific, Palo Alto, CA, USA) was used to confirm and quantify residues in honey samples.

RESULTS

The ASE method showed good linearity with determination coefficients equal to or higher than 0.99 for all of the compounds investigated. There was also good repeatability, demonstrating that the method is useful for monitoring compounds belonging to different chemical classes. The recoveries ranged from 97 to 102 % for PCBs and PBDEs, from 75 to 95 % for OCs and from 75 to 97 % for OPs. The six PCB indicators examined were detected in all samples, with similar concentrations for each molecule in the three different regions ranging from 0.27 to 0.92 ng g-1. Several OC pesticides were present; all honey samples from Calabria revealed the presence of Aldrin , with a concentration ranging from 1.95 to 18.9 ng g-1. In two honey samples, the values were close to the MRL. Samples from Trentino-Alto Adige are those in which there was a greater number of OCs. This situation is probably related to the fact that Trentino-Alto Adige is one of the major apple growing areas of Europe. Intensively cultivated apple plantations are subject to the extensive use of pesticides to control most agricultural pests, even if the integrated pest management system is applied during the growing season.

DISCUSSION

The presence of residues of several pesticides in the honey samples and organic contaminant residues indicate that bee colonies in the investigated regions are probably exposed to chronic impacts of pesticides. Furthermore, the results of the present study showed that the presence of the residues in organic honey may also be affected by the contaminant’s geographical area (e.g. the presence of an agricultural system) confirming honey bee and beehive matrices as appropriate sentinels for monitoring contamination in the environment. In agricultural areas with developed apiculture, useful information about the occurrence and distribution of pesticide residues due to crop protection treatments can be obtained from the analysis of collected honey samples, which were used as bioindicators. This approach is currently pivotal and could help beekeepers to select production areas, if dedicated to organic honey production, and to maintain food safety protecting human health.