Aquatic Sediment and Honey of APIs Mellifera as Bioindicators of Pesticide Residues

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Abstract : Brazil is the world's largest consumer of pesticides. The excessive use of these compounds has negative impacts on animal and human life, the environment, and food security. Bees, crucial for pollination, are exposed to pesticides during the collection of nectar and pollen, posing risks to their health and the food chain, including honey contamination. Aquatic sediments are also affected, impacting water quality and the microbiota. Therefore, the analysis of aquatic sediments and bee honey is essential to identify environmental contamination and monitor ecosystems. The aim of this study was to use samples of honey from honeybees (Apis mellifera) and aquatic sediment as bioindicators of environmental contamination by pesticides and their relationship with agricultural use in the surrounding areas. The sample collections of sediment and honey were carried out in two stages. The first stage was conducted in the Bituruna municipality region in the second half of the year 2022, and the second stage took place in the regions of Laranjeiras do Sul, Quedas do Iguaçu, and Nova Laranjeiras in the first half of the year 2023. In total, 10 collection points were selected, with 5 points in the first stage and 5 points in the second stage, where one sediment sample and one honey sample were collected for each point, totaling 20 samples. The honey and sediment samples were analyzed at the Laboratory of the Paraná Institute of Technology, with ten samples of honey and ten samples of sediment. The selected extraction method was QuEChERS, and the analysis of the components present in the sample was performed using liquid chromatography coupled with tandem mass spectrometry (LC-MS/MS). The pesticides Azoxystrobin, Epoxiconazole, Boscalid, Carbendazim, Haloxifope, Fomesafen, Fipronil, Chlorantraniliprole, Imidacloprid, and Bifenthrin were detected in the sediment samples from the study area in Laranjeiras do Sul, Paraná, with Carbendazim being the compound with the highest concentration (0.47 mg/kg). The honey samples obtained from the apiaries showed satisfactory results, as they did not show any detection or quantification of the analyzed pesticides, except for Point 9, which had the fungicide tebuconazole but with a concentration <LOQ. In the Bituruna municipality, no pesticides were detected in the analyzed samples. Thus, it can be concluded that pesticides in honey and sediment samples indicate environmental contamination related to agricultural activity, proximity to intensive agricultural areas, and pesticide use. The absence of pesticides does not guarantee their total absence, and other sources of contamination should be considered. Regions with less agriculture and dense vegetation may show lower pesticide presence due to limited exposure and the natural barrier of vegetation. Therefore, pesticides detected in honey and sediment samples are indicative of environmental contamination in the surrounding area and, thus, can be considered bioindicators of environmental quality.

Keywords : contamination, water research, agrochemicals, beekeeping activity

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