Development of a lateral flow test for rapid pyrethroid detection

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The WHO (Word Health Organization) defines “disinfection” as the procedure whereby health measures are taken to control or kill the insect vectors of human diseases including dengue, yellow fever and malaria.[1] After the unprecedented spread of the Zika virus (South America, Brazil) in 2016,[2] the employment of type-I pyrethroids for airplane disinfection on inbound flights from the tropics thus increased in recent years. However, means to control for proper spraying to guarantee effective disinfection and avoid possible onset of symptoms in passengers and crew members, especially children and sensitized subjects, underlines the necessity to develop sensing schemes for the rapid detection of these pesticides directly at the point-of-use.[3] The aim of the presented work was the development of such a simple, rapid and effective method for pyrethroid analysis. The analysis will provide a semi-quantitative estimation of the insecticide levels, in order to have a control over the amount necessary to efficiently kill mosquitoes, while maintaining non-hazardous concentrations inside the passenger and crew cabins.

An antibody-gated indicator-releasing mesoporous material[4-6] was thus developed to class-selectively indicate type-I pyrethroids. The material shows various new features from the reported ones such as a pore size better adapted to the antibody caps, a localized hapten grafting and secondary poly(ethylene glycol) (PEG) functionalisation, all contributing to the fact that now micron-sized scaffold particles can be used without compromising kinetics or blank release. The implementation into PEGylated glass fibre membranes allows for lateral-flow assay-based analysis, employing a smartphone for readout. It was possible to detect Permethrin (type-I pyrethroid) at concentrations down to 1 ppb in less than 5 min, using a 3D-printed case as the strip holder and a smartphone for signal readout.[7] The reported method is not only a simple alternative for testing for pesticide residues on airplanes but is modular and can thus be adapted for many different analytes and field analytical scenarios for instance in point-of-care and point-of-need diagnostics.

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