

Diffuse reflectance spectroscopy for mosquito surveillance

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Rapid, low cost, high-throughput tools for vector surveillance are urgently needed to develop and optimise new vector control strategies, as vector borne diseases (VBD) are spreading around the globe due to climate change and globalisation, and endemic countries are suffering resurgence of malaria cases following weakening of control tools. Mid-infrared spectroscopy (MIRS) combined with machine learning analysis has shown potential for quick and efficient identification of mosquito species and age groups, which are key traits monitored in VBD surveillance programmes. The main advantages of this optical method are its speed, lack of sample preparation, low cost and established protocols and analysis pipelines. However, current MIRS technology to collect spectra is destructive to the sample and does not allow targeting specific tissues of the mosquito, limiting the identification of other important biological traits such as insecticide resistance. Here, we assessed the use of a non-destructive approach of MIRS for vector surveillance, micro diffuse reflectance spectroscopy (μ DRIFT) using mosquito legs to identify species, age and cuticular insecticide resistance within the *Anopheles gambiae* s.l. complex. We measured a total of 344 samples from two species, *An. coluzzii* and *An. gambiae* and two age groups, 3 and 10 days old. Different parts of the mosquito were scanned using μ DRIFT to assess their suitability. Legs required significantly less scanning time and showed more spectral consistence compared to other mosquito tissues. Logistic regression was able to identify species (*An. gambiae* and *An. coluzzii*) with an accuracy of 73%. Random forest differentiated the two ages groups with 77% accuracy, and we obtained accuracy of 75% when identifying cuticular insecticide resistance using support vector machines. Our results highlight the potential of different mosquito tissues and μ DRIFT as a tool for biological trait identification on mosquitoes that transmit malaria. By targeting different parts of the mosquito, it opens the possibility to increase MIRS versatility to monitor insecticide resistance and beyond. Our results can guide new ways of identifying mosquito traits which can help the creation of innovative surveillance programs by adapting new technology into mosquito surveillance and control tools.