Monitoring biological age in mosquitoes using infrared spectroscopy

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Background: The age of vector populations is the most important factor that determines vectorial capacity, hence disease transmission. However, there are no effective methods to measure age structures in mosquitoes. Infrared spectroscopy (IRS) with machine learning (ML) models have shown promising results as all-in-one solution to determine the age of malaria vectors. However, models trained with laboratory reared mosquitoes require re-calibration to generalize and predict the age of wild samples. This extra step is caused by the different ageing rates between laboratory reared and field collected, which are exposed to different environmental conditions. Here, we characterized how temperature affects ageing rates in mosquitoes and how these changes are reflected in IRS spectra to produce ML models that can predict the biological age of mosquitoes and generalize across different ecological settings.

Methods: The effect that temperature has on biological age was tested using two different average temperatures: 24 and 27°C and with two different ranges: ±3°C and ±6°C using environmental chambers. The survival of two major malaria vectors (*Anopheles coluzzii* and *An. gambiae)* was monitored for approximately 30 days across different replicates, in the presence and absence of a sublethal exposure of deltamethrin insecticide. Mid infrared spectra of mosquitoes at different time points were obtained and their life expectancy was analysed to determine their biological age.

Results: Mosquito survival varied depending on temperature, insecticide exposure and species. Accuracy for predicting biological age was higher compared to chronological age, suggesting that IRS signal is directly associated with mosquito ageing rates. Ongoing analysis will validate these models in mosquitoes reared in semi field settings and collected from the field.