Comparative Analysis of Acoustic Propagation Parameters of Natural Sounds of *Anopheles gambiae s.s* and *Odorrana tormota* Significant in Mosquito Startle

Abstract

Acoustics of varied frequency ranges generated naturally by animals or artificially by electronic devices have shown startle effect to insects. It has been shown that mosquitoes use the reactive near-field in antennae communication with negative phonotaxis in male *Aedes diantaeus* evoked by low frequency acoustic signals of a carrier frequency 140–200 Hz. Also, studies with the 35-60 kHz *Odorrana tormota* sound recorded a 46 % repellence in female *Anopheles gambiae*, the malaria vectors. Declining malaria morbidity and mortality is attributed to current vector and pathogen interventions. However, the rate of decline in malaria morbidity and mortality is impeded by buildup of resistance in pathogens and vectors to chemicals. This study therefore characterised animal sounds essential for further investigation in the control of malaria through mosquito startle. The research determined, analysed and compared the acoustic propagation parameters of the recorded natural sounds of the male *Anopheles gambiae*, female *Anopheles gambiae* and *Odorrana tormota* using Avisoft SASLAB Pro and Raven Pro 1.5. All sounds were observed to have frequency modulation with harmonics stretching to ultrasonic levels. Uniquesly, the sound of *O. tormota* showed constant frequency modulation. The pupae of *A. gambiae* were reared in vials quarter filled with water and covered with a net at 60-80 % humidity, 25±2 ˚C temperature and equal light-darkness hour cycle at Kenya Medical Research Institute (KEMRI) entomology laboratories. The parameters showed a significant deference in fundamental frequency (maximum entire), Peak amplitude (maximum), peak amplitude (mean), Peak amplitude (mean entire) and peak amplitude (maximum entire) of the sound of male *A. gambiae* and *O. tormota* ($p < 0.05$). The maximum frequency (minimum entire) of both sexes of *A. gambiae* was equal (1.90 kHz) with variability being observed in maximum frequency (end), maximum frequency (maximum), maximum frequency (mean), maximum frequency (maximum entire) and maximum frequency (mean entire). Frequency (maximum). A paired samples t-test comparison of the maximum frequency (mean), maximum frequency (maximum), maximum frequency (end), maximum frequency (maximum entire) and maximum frequency (mean entire) of the sound of the female *A. gambiae* and male *A. gambiae* indicated no significant difference between the sounds ($p > 0.05$). The maximum frequency (mean) of the sounds of both sexes of *A. gambiae* correlated highly negative ($r = -0.658$). The bandwidth (end), bandwidth (maximum), bandwidth (maximum entire), peak amplitude (mean)

and bandwidth (mean entire) of the sound of the male compared with female *A. gambiae* differed significantly. The signal power for the non-pulsate sounds of the male *A. gambiae* remained almost constant at 80 dB from 10 kHz to 65 kHz beyond which the acoustic energy declining to 45 dB. Also, the sounds of the female *A. gambiae* did not exhibit any spikes in power but remained steady at 85 dB from 10 kHz up to 60 kHz beyond which the acoustic energy declined to 50 dB. The signal power of the pulsate sound of *O. tormota* was 89 dB. The propagation parameters of the male mosquito and O. tormota compared favourably indicating its potential in the startle of the female mosquito.

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