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Malaria transmission dynamics and insecticide resistance of *Anopheles funestus* during indoor spraying in northern Ghana

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Abstract

Malaria remains a major public health problem in Africa, with *An. funestus* as one of the principal vectors. In the control of malaria, indoor residual spraying (IRS) is an existing front-line measure and has been implemented in some sites in northern Ghana where the inhabitants mostly engage in farming and other agricultural activities. The effect of IRS on *Anopheles funestus* is poorly understood, hence, this study was aimed at investigating the species composition, malaria transmission and insecticide resistance status of *An. funestus* group in three selected sites in Northern Ghana. Samples were collected using human landing catch (HLC) and pyrethrum spray collection (PSC) techniques from two IRS areas (Tolon and Savelugu Districts) and one non-IRS area (Tamale District). Archived samples (2010, 2013 and 2014) and newly collected samples (2015) were analysed. A total of 688 adult female mosquitoes morphologically identified as *An. funestus* were recorded: 85.32 % from Tolon, 3.20 % from Savelugu, and 11.48 % from Tamale. PCR analysis confirmed that *An. funestus sensu stricto* was the only member of the group present. Man-biting rates of the mosquitoes collected in Tolon district was significantly higher ($p < 0.001$) than the other study sites. ELISA testing of mosquito heads and thoraces for *Plasmodium falciparum* circumsporozoite protein showed sporozoite infection rates of 2.98 % in Tolon, 0 % in Savelugu, and 1.43 % in Tamale, which were not statistically significant ($p > 0.05$). Blood meal analysis of the abdomen of these mosquitoes using ELISA revealed an overall human blood index of 31.50 %, 18.18 % and 32.86 % for Tolon, Savelugu and Tamale Districts across the years and a statistically significant difference ($p < 0.001$) between the study sites. PCR detection of *kdr* gene analysed in these mosquitoes showed 38.57 % possible mutation of the target site from samples collected in Tolon District. The results from this study indicate the importance of *An. funestus s.s* as an effective malaria vector especially in Tolon district with agricultural activities and insecticide resistance. The emergence of insecticide resistance and continued malaria transmission emphasises the need for continuous entomological surveillance and implementation of integrated vector management strategies to preserve the efficacy of IRS.

Keywords: Agricultural activities, *Anopheles funestus*, indoor residual spraying, malaria, northern Ghana, public health, vector control