Insecticide resistance in the Mexican malaria vectors from the transmission foci

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Since 1998, the malaria control programme in Mexico has been applying an integral management strategy focalised in five endemic regions along the Pacific Ocean coast (PAHO, 2002), and completely substituted the use of DDT for a pirtehroid since 2000. Previously, malaria control activities were mainly based in the use of insecticides during almost half century. The insecticide used in public health, together with that used in agriculture, has been exerting a selective pressure on malaria vectors, resulting in multi resistant mosquitoes, as it occurs in *Anopheles albimaus* that is resistant to a wide number of insecticides on the Chiapas coastal plain (Penilla, et al., 1998). We present here the insecticide resistance levels in the three vectors from the malaria transmission foci in Mexico: *An. pseudopunctipennis, An. albimanus* and *An. vestitipennis*.

Anopheline mosquitoes were collected from 2003 to 2005 in the states of Tabasco, Chiapas, Oaxaca, Michoacan, Nayarit and Sinaloa, using human landing collections, resting mosquitoes in corrals, and larval collections. F1 generation mosquitoes were tested with DDT, deltamethrin (pyrethroid), pirimiphos methyl (organophosphate) and bendiocarb (carbamate) in susceptibility tests using the WHO diagnostic concentrations (WHO, 1975). Levels of the enzymes involved in insecticide resistance were measured by biochemical assays.

All anophelines were carbamate (CARB) susceptible in Tabasco, Chiapas and Oaxaca, but *An. pseudopunctipennis* was CARB resistant in Michoacan (77%-99% of mortality) and Sinaloa (36%-71% of mortality). The acetilcholinesterase (AChE) resistance gene frequences were well correlated with the CARB resistance grade present in the last two states.

An. albimanus was organophosphate (OP) susceptible in the Lacandon forest, Tabasco and Michoacan, but was lightly resistant in Oaxaca (96%-100% of mortality) and resistant in Chiapas (78%-90% of mortality). *An. vestitipennis* was lightly resistant in the Lacandon forest (96% to 100%), as *An. pseudopunctipennis* in Michoacan (97% of mortality). The later was OP resistant also in Oaxaca (87%-92% of mortality), and Sinaloa (12% and 19% of mortality). Both AChE and esterase based-mechanisms showed correlation with the OP resistance.

All anophelines from the five states were DDT resistant, with mortalities ranging between 4% and 92%, but *An. pseudopunctipennis* from Sinaloa was the most resistant (4%-7%), followed by those from Michoacan (16%-20%). The glutathione s-transferase activity levels were high in all mosquito populations, indicating a metabolic resistance mechanism. However levels in Sinaloa and Michocan were not high enough to confer that DDT resistance, suggesting also the presence of a no metabolic mechanism.

An. albimanus was pyrethroid (PYR) resistant in Chiapas, Oaxaca, Tabasco and Michoacan, with mortalities ranging between 61% and 100%, and *An. vestitipennis* was lightly resistant in the Lacandon forest (96%-100%). *An. pseudopunctipennis* was PYR resistant in Oaxaca (88%-100%), Michoacan (81%-94%), Nayarit (63%) and Sinaloa (60% and 69%). Biochemical assays showed that both monooxigenases and esterases could be conferring PYR resistance in most of the mosquito populations. However, monooxigenases were not elevated in those from Michoacan and Sinaloa, another indication of the presence of a no metabolic mechanism, which could be conferring cross resistance to DDT in these two states. Both metabolic assays and the investigation of the presence of kdr are under way to confirm this data.