STATUS AND MECHANISMS OF INSECTICIDE RESISTANCE IN ANOPHELINE VECTORS OF MALARIA IN SRI LANKA

M.D.B.Perera
Regional Office, Anti Malaria Campaign
Kurunegala
Sri Lanka

Resistance to insecticides was studied in the major malaria vector *An. culicifacies*, and secondary vector *An. subpictus* in five districts (*i.e.* Anuradhapura, Kurunegala, Moneragala, Puttalam and Trincomalee) of Sri Lanka during January 2001 to January 2005. Adults were collected using cattle baited trap huts. Larvae were collected from natural breeding habitats. Adult bioassay experiments were carried out with World Health Organization (WHO) discriminative dosages of DDT, malathion, fenitrothion, propoxur, lambda-cyhalothrin, cyfluthrin, cypermethrin, deltamethrin, permethrin and etofenprox, according to WHO standards. Metabolic resistance by carboxylesterase, glutathione S-transferase (GST) and monooxygenase based mechanisms were determined by biochemical, synergist and metabolic techniques. Target site insensitivity was studied by biochemical assays and gene sequencing. Resistance in other potential malaria vectors from Anuradhapura was also studied.

Both species were highly resistant to DDT in all the collected places. Malathion and fenitrothion resistance was high in all the places except *An. culicifacies* in Kurunegala (susceptible to both) and Puttalam (susceptible to fenitrothion). Populations were highly resistant to permethrin in Anuradhapura and Trincomalee. All the populations were susceptible to cypermethrin and cyfluthrin. *An. subpictus* from Anuradhapura, Kurunegala and Puttalam were resistance to lambda-cyhalothrin. All *An. subpictus* populations had low susceptibility to deltamethrin. Etofenprox tolerance was highest in Anuradhapura *An. subpictus*.

Carboxylesterase activities were higher in *An. culicifacies*. Native PAGE resolved one elevated isozyme band from each species. Thin layer chromatography analysis of metabolized mosquito homogenates showed the presence of malathion carboxylesterase mechanism in all the populations except for Kurunegala *An. culicifacies*. AChE was more sensitive to insecticides in Kurunegala and Trincomalee *An. culicifacies* populations and highest insensitivity was observed from Trincomalee *An. subpictus* population.

High GST activities in both species explained their high resistance to DDT. Quantitative and qualitative changes of carboxylesterases, and insensitive target site AChE were found to be responsible for organophosphorus resistance in Anuradhapura, Moneragala, Puttalam and Trincomalee *An. culicifacies* populations. Synergist and biochemical studies revealed that monooxygenases provide pyrethroid resistance.

An. subpictus, *An. nigerrimus* and *An. peditaeniatus* showed resistance to propoxur showing the high exposure of their breeding sites to agricultural insecticides. *An. nigerrimus* and *An. peditaeniatus* have developed insecticide resistance mainly due to elevated monooxygenase activities.

Leucine to phenylalanine substitution (TTA to TTT) in sodium channel regulatory gene was detected from Anuradhapura *An. subpictus* and was almost identical to the mutation identified in *An. gambiae s.s.* of South Africa. This indicates an independent origin of the same mutation in two geographically isolated species due to the constraints for evolving different mutations without interrupting the physiological role of the target site. It appears that pyrethroid resistance of Sri Lankan *An. culicifacies* is mainly caused by monooxygenases and that of *An. subpictus* is mainly by mutated sodium channel genes.