Combatting malaria using natural mosquito repellents

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Repellents derived from Greek herb extracts show potent effects, as spatial repellents, against malaria carrying mosquitoes, and possibly others.

A major challenge in combatting malaria is to develop effective yet sustainable mosquito repellents. Now, the ENAROMaTIC project, a European effort to reduce the spread of malaria completed in 2012, may have done just that. Project coordinator Kostas Iatrou, talks to youris.com about how the project came up with new herb-based repellents. Iatrou, who is a professor and research director at the Institute of Biosciences and Applications at the National Centre for Scientific Research Demokritos, in Athens, Greece, also relates how such repellents may have a broad-spectrum use against other mosquito-borne diseases.

What was the approach taken to find novel compounds?

We started with the teaching of the folk culture. For example, it was well-known that putting basil in front of people's house can help keep mosquitoes away. We investigated the possibility that certain aromatic plants and herbs contain substances that repel mosquitoes. So we collected about 350 aromatic plants from the mountains of Attica, Greece, and from botanical gardens in the area. We then analysed essential oil extracts of 80 plants.

We found that some of them can either significantly repel or attract mosquitoes. A few were used to isolate constituent chemical compounds that functioned as deterrents to mosquitoes. And this resulted in identification of four active compounds. We then filed patent applications on them, alone and in combinations. Our partners in Switzerland at the University of Neuchâtel are taking further action to exploit these patents.

What did the research aim to do?

Mosquitoes by nature detect people through odours, volatile molecules emitted by the human skin, their breath and their temperature. We tried to intervene in the mosquito olfactory function, in a way that they will no longer be able to detect and direct themselves to humans. Our ultimate goal was to identify compounds capable of interfering with the olfactory function of mosquitoes by causing olfactory disorientation. These would act as strong odour-based mosquito repellents or attractants. In effect, they would antagonise those emitted by the human skin but would be safe for human application.

We developed new methodologies and procedures that allowed us to investigate the specificity of odour recognition between odorant binding proteins and receptors in Anopheles gambiae mosquito. By comparison, the industry uses conventional trials to discover new mosquito repellents that take too much time and money. Using conventional approaches, about ten years and 30 million dollars are needed to bring a new repellent in market.

How did you test your compounds?

We did several trials to test these compounds as spatial repellents in natural field sites in Nigeria. Initially, we used them in model huts,

similar to those used by people in African villages, with human presence. We used various combinations of our compounds not on human skin but in open containers that acted as sources of vapours that may affect mosquito olfactory function in the rooms. These huts are designed in such a way that when the mosquitoes are repelled, they try to escape through a window, where they are trapped. In this way, in the next morning we could see how many mosquitoes were trapped trying to leave the rooms and how many were still in the hut. In all our tests, we also used DEET in order to get comparative results. The results were very successful, as it was obvious that our compounds were at least as active as DEET. After the model hut trials, we visited an actual village in Nigeria where we repeated our tests.

Did you have any unexpected results?

The results were great. But we also discovered even more interesting aspects of these molecules. Our compounds were designed using the components of the smelling machinery of the Anopheles mosquito, which is the carrier of malaria. Yet the same compounds had significant repellent action against a wide variety of blood feeding and biting insects, like the Culex mosquito. These are also endemic to the tested regions and are, in general, carriers of other infectious diseases, including West Nile Virus.

What are your plans for future research?

Mosquitoes develop impressive resistance mechanisms against many things that are unfavourable to them. These include insecticides and, possibly, repellents as well. We want to be ready for resistance mutations to specific repellents. For this reason, we are already expanding our 'arsenal'. We still have a variety of herbs and other plants that have not been analysed, as well as a large collection of additional plants from the

island of Crete, Greece that could be assessed, if necessary. In addition, we are putting together a consortium with major Greek players, to tackle mosquitoes that are carriers of infectious diseases.

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