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Science news

Mosquito control: Indian scientists show a novel way

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Many Indian cities grappling with the annual post-monsoon surge in dengue and malaria have news to cheer about. Researchers from Bengal Engineering and Science University (BESU) have reported an incredibly cheap and easy way to control mosquitoes with the help of carbon nano-particles [1].

They claim that adding very small quantities of water soluble carbon nano-particles (wsCNPs) to stagnant water prevents mosquito larvae to grow into adult mosquitoes, thereby potentially eliminating the need for hazardous chemical sprays. The researchers have shown that larvae ingesting the nanoparticles simply die in four weeks without ever attaining the pupal stage.

"The method is important in the context of India and other developing countries," Sabyasachi Sarkar, formerly head of chemistry at the Indian Institute of Technology in Kanpur and a co-author of the study told *Nature India*.

The researchers (L to R): Sabyasachi Sarkar, Sumit Sonkar & Manav Saxena

Interestingly, their study was prompted by earlier research which found that smoke produced from the burning of domestic fuels, such as firewood, coconut husks and dried plant leaves, has strong mosquito-repellent property. The researchers had shown that smoke contains carbon nanotubes along with nanoparticles suggesting that carbon nanomaterials may have a role in controlling the activity of mosquitoes. Their latest study was aimed at verifying this hypothesis.

The preparation of wsCNPs itself requires no sophisticated set up. For their study, the researchers burnt wood waste under reduced oxygen in an earthen bowl loosely covered by a dish and collected the soot deposited on the dish. The soot was washed with acetone, air dried and then oxidized by nitric acid — a treatment that yielded spherical water soluble "fluorescent" wsCNPs of size ranging from 5 to 30 nanometres (a nanometre is one billionth of a metre). The ability of these nanoparticles to "fluoresce" was exploited by the scientists to image the development of the various stages of the mosquito's life cycle — from larva to adulthood — using an optical fluorescence microscope. "We have monitored the growth of mosquitoes under varying doses of wsCNPs under laboratory conditions," their report says.

The researchers experimented on Anopheles, Aedes and Culex species of mosquitoes known to transmit malaria, dengue and filariasis respectively. To study the effect of wsCNPs on the life cycle of these mosquitoes, their one day old larvae were cultured in tap-water filled homemade aquariums treated with different amounts of the nanoparticles. As a food supplement, equal quantities of sucrose and some vegetable juices were added in all aquariums. In another aquarium, they cultured "control" larvae under identical conditions but without wsCNPs.

The researchers found that 99% of the larvae under control condition were converted to pupae to attain

adulthood within 7 to 10 days. However 30-35% of larvae growing in water treated with the dose of 1.0 milligram per litre (mg/l) to 2 mg/l did not attain adulthood and died. "When the concentration of wsCNPs was raised to 3.0 mg/l in the breeding water, the larvae did not become pupae even after the 25th day," the researchers said. "Such prolonged stay at the larval stage led to death of the larvae."

The wsCNPs at a concentration above 3.0 mg/l can sufficiently slow down the metabolism in the larval stage of mosquitoes thus preventing them from becoming pupae and finally causing death. The stability of the wsCNPs even in solution form made these nanoparticles a potent alternative to chemical spraying, their report says. Based on their observation that zebra fish can use the dead larvae as food with no ill effect the researchers suggest that treatment of stagnant water with wsCNPs can curb mosquito growth without affecting non-target organisms in the ecosystem.

People, especially in third world countries, can use this low cost material in stagnant water near their homes and establishments during breeding seasons to arrest the menace of mosquitoes, the researchers suggest. More importantly, use of this material does not require any instruments or special skills.

However, the researchers admit that they do not yet know the exact mechanism by which the nanoparticles block the growth of mosquito from larval stage to adulthood. "The effect of wsCNPs on the hormonal activity of larvae requires further study to find out the biochemical events responsible for the slowdown of the metabolism (in mosquito larvae)," the report says.

References

1. Saxena, M. *et al*. Water soluble nano carbons arrest the growth of mosquito. *RSC Adv*. (2013) doi: **10.1039/C3RA44100H**

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