

What's your defence against mosquitoes? Mosquito repellent mats, creams, sprays, and nets... Has it ever crossed your mind that the nation's Defence Research and Development Organization, or the DRDO as we know it, is also working towards defending you from mosquitoes?

Defence Weaponry against Mosquitoes

"People who claim they don't let little things bother them have never slept in a room with a single mosquito."

DRDO has made significant contributions to India's strategic defence system over the last five decades. It often awes us with its contributions to the development of missiles such as Agni, Prithvi, Akash and Nag or the majestic battle tank Arjun. But the organization's efforts are not limited to the development of arms and armament systems. Some spinoff benefits of DRDO's efforts have found immense use for the society at large. One such line of research has helped provide defence against mosquitoes... one of man's deadliest enemies.

Some outcomes of DRDO's research include products such as the herbal mosquito repellent vaporizer (*Mosout*), room freshener-cum-mosquito repellent (*Aeromos*), water-based herbal mosquito repellent (*Aquamos*), poly herbal mosquito repellent (*Mosquit*), biological mosquito control agent (*Spheritox*), herbal floating tablet as mosquito larvicide (*Flotkil*) and the lure and kill technology (*Attracticide*).

Mosquitoes... Man's Deadliest Enemies

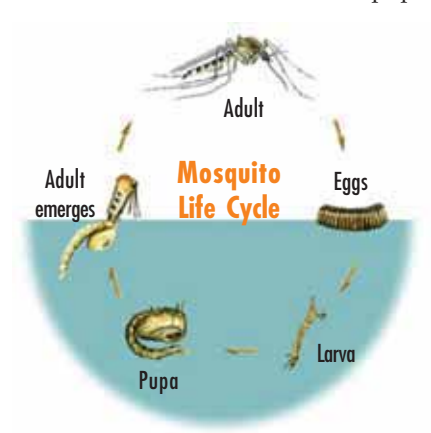
Mosquito bites are annoying. Worse, they cause serious diseases in humans, dogs, horses and other mammals. Mosquitoes make nearly 700 million people sick every year and that often results in millions of deaths globally. Malaria is the number one killer among infectious diseases in India. Dengue has also become a huge threat in India. According to the Ministry of Health and Family Welfare, in 2008 alone the country recorded over 12,000 cases of dengue. This is more than double recorded in the year 2007.

Other than these two more common diseases, different types of mosquitoes also transmit worms, viruses and parasites that cause diseases such as

- Filariasis (an infection by round, thread-like parasitic worms that inhabit the lymphatic system);
- Chikungunya (a viral illness causing fever and severe joint pain);
- Yellow fever (a potentially fatal acute viral hemorrhagic fever);
- Epidemic polyarthritits (an influenza-like illness associated with inflammation and pain of multiple joints in the body);
- Rift Valley fever (a viral zoonosis that may infect humans);
- West Nile fever (a viral infection that can cause fever, skin rashes and inflammation of the brain and its surrounding meninges) and;
- Japanese encephalitis (a serious illness causing inflammation in the brain).

Know Thy Enemy

There are about 3500 species of mosquitoes. They go through four distinct stages during their lifecycle. When magnified under a microscope, the different stages will look as shown in the figure. First an adult mosquito lays eggs in stagnant water. Then the larva comes out of it. It turns into pupa



out of which adult mosquito emerges. After it dries its wings it is ready to fly. Interestingly, male mosquitoes do not bite. They typically feed on nectar and other plant juices. Only the females of some species need a 'blood meal' to be able to produce eggs.

DRDO's Arsenal against Mosquitoes

DRDO has targeted several different modes of mosquito control.

DEPA spray

Its Life Sciences wing has developed a multi-insect repellent spray whose main constituent was N, N-diethylphenylacetamide (DEPA). This spray provided 6-8 hrs of protection from mosquito bites. The product is now approved by the Drugs Controller General of India (DCGI) and also the Director General of Armed Force Medical Services. Once sprayed on fabric, curtains or even skin, the DEPA spray keeps mosquitoes away for 6 to 8 hours.

The technology of spray formulation has been transferred to Confederation of Indian Pharmaceutical Industry (CIPI) for commercial production with BIS specification IS 14187. It would now be brought to the market for the "aam aadmi" by Jyothi Laboratories and Asian Herbex Ltd.



Anti-mosquito paint for your rooms

A slow release insecticidal paint developed by DRDO adds a new dimension to paint technology. In addition to decoration and preservation of wooden and metallic surfaces, this new paint keeps away mosquitoes, cockroaches and other insects by slowly releasing the safe

insecticide from the blended paint, achieved through a delicate balance of chemical formulation. It is a quick-drying paint with insecticidal activity for two years. The paint is ideally suited for use in kitchens, restaurants, warehouses, hospitals, rail coaches, etc.

Herbal mosquito repellants

If you thought insecticidal chemicals were toxic and dangerous for the environment, here's something interesting. DRDO has identified nearly twenty indigenous plants whose extracts and oils have been found to be effective against the larvae of mosquitoes. An herbal mosquito-repellent in spray formulation has been developed. It is also equally protective against fleas, bed bugs, and other blood-sucking insects. Another herbal insect-repellent cream with a coconut oil base when applied on the skin provides protection for five to six hours.

In a short communication published in the October 2006 issue of the *Defence Science Journal*, scientists from the Defence Research Laboratory



(DRL) at Tezpur pointed out that the bioactive organic chemicals obtained from plant

sources had been found to be less toxic and less prone to development of resistance than other synthetic insecticides. Moreover, they were also easily biodegradable and more cost effective.

Concerned about the effects of chemical vapors released from some synthetic mosquito repellants on the health and hygiene of children in your house? Here's an option you might want to try ... the herbal mosquito repellent vaporizer from DRL's quiver. This eco-friendly herbal formulation is 100% natural and evaporates slowly with fragrance to keep away mosquitoes and other biting insects. A patent has been filed for this product and the user trial has been completed. The transfer of technology for commercial production is in the pipeline. Once in the market, this could well be a safe alternative to synthetic anti-mosquito vaporizers.

Non-electric mosquito repellent liquid vaporizer

When you are camping outdoors in a tent with no electricity, you have to do without your electric mosquito repellent vaporizer. Moreover, electricity is yet to reach many remote villages of the country. In such conditions, DRDO's non-electric mosquito repellent liquid vaporizer comes in handy. The "Mosquito Vaporizer" kit consists of a kerosene oil burner that emits heat. This vaporizes the herbal liquid integrated to the burner. The vapours thus emitted repel the mosquitoes away.



Mosquito biolarvicide

Generally, synthetic insecticides are used to kill mosquitoes. These are not eco-friendly. DRL, Tezpur has been successful in developing a mosquito biolarvicide of 10% powder formulation using a kind of soil bacteria called *Bacillus sphaericus*.



The bacteria act against the larvae of *Culex* and *Anopheles* mosquitoes through a toxin that is released upon destruction of the bacterial cell wall. The toxin causes disintegration of the gut wall, cessation of feeding activity, starvation and leakage of gut contents into the circulatory fluid or hemolymph and the body cavity of the mosquito larvae causing paralysis or death.

A Knapsack sprayer is used to spray the larvicide uniformly over the surface of water where mosquitoes breed. The user trial for this product is in process.

Herbal Floating Tablet Mosquito Larvicide

Spraying of mosquito larvicides is fine. But how do you spray a larvicide into tree holes where water collects...or maybe even collection of water in smaller pots and containers? We hardly hire somebody to spray a larvicide into our coolers where we know mosquitoes so often breed.

DRDO has a solution. It has developed a technology for control-release of herbal larvicide called "Herbal Floating Larvicide Tablet" or Floatkil. It is a larvicide tablet with biodegradable herbal floating and

binding materials impregnated with it. The tablet is effective for 30



days. One single tablet is sufficient for one square meter of open water surface.

But won't the mosquitoes start laying eggs again? In a few weeks' time, won't their population inevitably increase as they start developing resistance? DRDO comes to your rescue once again. It has developed an 'attracticide' that has 'lure and kill' properties.

Lure and kill attracticide

Aedes aegypti mosquitoes prefer to lay eggs on water containing the larvae of the same species. Even after the larvae are removed, for several weeks the larval water seems to attract adult mosquitoes to lay eggs in the same place. Pheromones or sex hormones seem to play a role here. For the first time in the world, DRDO has been able to isolate and identify these pheromones. It has also been successful in producing these sex hormones synthetically.



Using this attractant along with insect growth regulators, the DRDO has formed an attracticide that lures female mosquitoes into laying eggs in the water containing such attractant. Though the eggs hatch into larvae, they do not reach adulthood.

Field trials in Delhi, Maharashtra, Kerala and Tamil Nadu have confirmed the effectiveness of this 'lure and kill' technology in controlling the population of *Aedes aegypti* mosquitoes. This technology is patented in India. Technology transfer to a US-based firm, Crompton Corporation, is under progress.

When you go to bed, remember to be thankful to the research scientists at DRDO for their constant efforts in making your lives more peaceful even as you sleep.

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