

A quick look at mosquito repellents

DEET is the most widely used and studied synthetic mosquito repellent in human history. DEET-based products are very effective, and should not be harmful if all label instructions and precautions are followed and the product is used safely.

Icaridin (picaridin, KBR 3023) and **IR3535** are also reliable mosquito repellents frequently referred by the World Health Organization (WHO). Moreover, there are other mosquito repellent products available in the market, but they may not be equally reliable.

“Natural” alternatives with certain level of efficacy

Some companies may claim or imply that “natural” products are safe simply for being natural (or organic, etc). However, exacerbating the risks of synthetic products while ignoring the risks of their own products is dangerous and irresponsible. Inclusion of natural ingredients in a mosquito repellent does not necessarily mean that the product is risk-free. “Natural” products must also undergo stringent studies on safety and efficacy before being considered as reliable mosquito repellents. Moreover, the safety of *any* repellent, including plant-based products, is never guaranteed in case of misuse, which often involves excessive application or ingestion.

Although some plant-based repellents may be approved, recommended or allowed by regional or national agencies, their local considerations including the local vector distribution might not be applicable to other areas. Nevertheless, when appropriately formulated, all these are believed to provide a certain level of protection against nuisance mosquitoes. However, products of essential oils such as oil of lemon eucalyptus (OLE) and citronella oil may be considered unsuitable for children under 2-3 years old, whilst reported protection of citronella oil and soybean oil products may last for only 20-30 minutes and 90 minutes respectively [1]. Methyl nonyl ketone (MNK, “wild tomato extract”) does not have appreciably long history as a mosquito repellent, and is often absent in peer-reviewed scientific literatures comparing various mosquito repellents. In the European Union, whilst MNK was approved for animal repellent products, further verification revealed that such approval (evidently withdrawn recently) was instead intended for use against terrestrial vertebrates including dogs and cats (not a repellent used *on* pets) [2, 3], thus modest behavioural changes of pets is possible after application on human.

Unreliable alternatives

Other plant-based products (including other essential oils) may also offer some degree of protection, yet they seldom achieve sufficient protection in field studies, and many are skin irritants at low concentrations [4]. Lavender oil, sometimes claims to be effective when only drops are required in “homemade” repellent recipes, may at best offer protection for 30 minutes [1]. Rue oil, with MNK often a major component, may look attractive as a natural mosquito repellent. However, its high MNK content

may reportedly affect the uterus, and rue oil has even been documented to cause localized skin reactions, abortion, and other adverse effects including death [5]. Worse still, when rue oil is diluted to match the MNK concentration of a commercial repellent, it could be a phototoxic skin irritant [4]; yet its repellency would likely be inferior to some commercial MNK products which also carry an extract of the more conventional lemon eucalyptus as an unadvertised source of repellency.

People normally avoid moving into high-risk areas without any personal protection. Thus when an unreliable repellent product is mistakenly trusted and applied, there could actually be greater health risk than not using anything at all (without even considering the intrinsic toxicity of the product). Special care must always be taken during product selection. Products not explicitly labelled for use as mosquito repellents or those without detailed instructions and precautions are undesirable for disease prevention, as their safety, quality and efficacy are not proven.

[1] <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC167123/>

[2] <http://onlinelibrary.wiley.com/doi/10.2903/j.efsa.2012.2495/epdf>

[3] <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32017R0781>

[4] <https://malariajournal.biomedcentral.com/articles/10.1186/1475-2875-10-S1-S11>

[5] <http://www.inchem.org/documents/pims/plant/rutagrav.htm>

What are inert ingredients?

The constituents of a pesticide that are responsible for the pesticidal effect is known as active ingredients. However, active ingredients alone usually do not function well as pesticides in controlling pests. Therefore, inert ingredients, in general, are any substances other than the active ingredients added during or after the production of pesticides for enhancement of effectiveness, stability and safety. Depending on usage of the pesticides, one or more inert ingredients will be added. They can be diluents, solvents, carriers, surfactants and other chemicals mixing in the pesticides to give their effects.

Diluents, solvents or carriers are added to the active ingredients to reduce their concentrations and / or correct the formulations of active ingredients, so that they can be applied in different situations. Surfactants include a lot of chemicals which serve as surface active agents basically improving the cohesiveness and dispersion of pesticides on treated surfaces.

Some commonly used surfactants are emulsifiers which stabilise the suspension of oil-form pesticides in water for space spraying; spreaders which allow pesticide, such as anti-malaria oil, to form a uniform layer over the treated surface; and wetting agents, which facilitate the solid form pesticides to mix with water, allow the pesticide to be dispersed by liquid sprayers.

Other common inert ingredients can be encountered in domestic pest control products, including attractants which are mixed with the active ingredients to increase the attractiveness of the pesticides to the target pests, such as anti-coagulant rodent baits. Dyes are also added to poisonous baits to warn any non-target species from contact or ingestion. Propellants which can be found in self-pressurised products act as the force to dispense the active ingredients from their containers. Some products may even have fragrances producing a pleasant sensation to the users.

Unlike active ingredients which must be revealed to the users through the labels and the material safety data sheets as bounded by law in many countries or unions, inert ingredients are the 'secret recipes' of the products. With same active ingredients, these 'secret recipes' actually differentiate brands. Recent concern over the safety of inert ingredients in pesticides to human beings, wildlife and environment has been growing as they may pose a bigger health risk than the active ingredients. Therefore, it is important for any people who wish to use pesticides as control measures use only the registered products according to their labels as approved by concerned authorities to ensure the local environmental and health standards are satisfied. Besides, appropriate personal protection equipment should be used to minimise the risk posed to themselves and the surrounding environment.