Dengue Prevention and Mosquito Repellents

Dengue cases have sky-rocketed this year, with Malaysia seeing a 347% increase from the same time last year [1] and Indonesia having the highest number in ASEAN [15].

Dengue is a mosquito-borne infection spread mostly by the Aedes aegypti mosquito. It causes flu-like illness, complications which can kill on average 2.5% of those infected [6].

There is no specific treatment for dengue, so prevention and control is essential. This includes removing breeding areas and minimising the risk of getting bitten [6].

How do I prevent mosquitoes breeding in and around my home?

- To prevent breeding empty or clean once a week any containers that contain water [5]:
  - Roof Gutters
  - Tyres / Toys
  - Stagnant Drains
  - Flower Pots
  - Sink Dish Tray
  - Tray under Refrigerator
  - Air-Con Trays
  - Wading Pools
  - Indoor Vases
  - Discarded Bottles/Cans
  - Cover Pools
- If you must keep open water outside (fountains or water features) regularly add a larvicide (e.g. Temephos) which will kill the mosquito larva in the water before they turn into adults.
- Ensure that insecticide fogging is conducted in your area only when a severe outbreak occurs, only during the early morning and only once or twice a week. Do not use continuously (to prevent resistance), never use inside your home and never use on your skin [24].

What can I do to prevent getting bitten?

- Use an insect repellent on yourself [NOT an insecticide/pesticide]. If you will be outdoors for a short time use a product with lower concentration of repellent [23] (see next section).
- Avoid being outdoors at dawn, dusk and at night when mosquitoes are active.
- Wear loose, light coloured protective clothing when outdoors, mosquitoes are attracted to dark colours, cover your wrists and ankles and wear socks.
- Install insect screens, use mosquito nets over beds and use a fan when you are sleeping.
- Use mosquito nets impregnated with permethrin (a pesticide/insecticide that kills mosquitoes).
- Insecticides contained in sprays, vaporisers, plug-in-mats, etc, can be effective but should be used with caution and in conjunction with other repellents, and NEVER on your body [5].
- We could not find any evidence that bug zappers or ultrasonic devices are effective [4] [5].
- Avoid wearing perfume; mosquitoes can be attracted to strong scents.
- The best electronic devices to kill mosquitoes in the house are traps – in our target countries you can buy traps that produce CO₂ (via photocatalyst under ultraviolet light) to attract the mosquito and then use a fan to suck the mosquito into the trap [4] [5].
- Also ensure that you keep containers of bug repellent and pesticides/insecticides locked away and out of reach from young children to reduce the chances of accidental poisoning.

What mosquito repellents should I use?

DEET (Diethyl-meta-toluamide) is the most effective mosquito repellent to use in countries with dengue or malaria (like our target countries listed in the header) [2] [3] [5] [12]. Be aware of the fact that DEET can cause skin irritation to people with sensitivity issues, but when used in low level concentrations (<30%) it should not pose a risk. Follow label instructions, as well as the below [2] [3] [5]:

- Test repellent on a small patch of skin before using it on you or your child’s skin, if you experience a negative reaction look at using botanical or synthetic repellents (next section).
- If you are worried about spraying repellent on your child’s/babies skin, spray on their clothing
- Apply only on exposed skin or on top of clothing (not underneath), and wash when finished.
Dengue Prevention and Mosquito Repellents

- Do not spray on the face, eyes, ears or on open wounds. For kids don't spray on their hands.
- If you have a reaction, stop using the product. Reapply repellents as required.
- People over 12 years – 30% concentration of DEET, which is effective for 6 hours. DEET above 30% does not yield better protection, but increases length of effectiveness.
- Children 2 to 12 years – 10% DEET, applied up to 3 times daily. Effective for 3 hours.
- Babies 6 months to 2 years – 10% DEET, no more than once daily. Effective for 3 hours.
- Under 6 months – Do not use DEET, use nets or stay away from mosquito areas if possible.

Multiple studies [7] [8] [9] [16] [28] show that when instructions and guidelines are followed DEET is NOT a health risk (though it may damage some plastics). DEET is 100% effective [10], which is important, as only one mosquito bite can cause dengue! In Malaysia the Drugs Control Authority has set a maximum level of DEET for sale at 20%, and recommended use above age 10 only [14]. None of our other target countries (listed in header) appear to have these restrictions, however Canada limits DEET sales to 30% concentration. The following repellents are less effective compared to DEET [2] [3] [5] [8] [10] [11] [12], but can still be used as a mosquito repellent:

- **Botanical Repellents:**
  - Oil of lemon Eucalyptus can be a good botanical alternative, it can be natural at 10% (OLE) or synthetic at 30-40% (PMD). NOT suitable for children under 3 [10].
  - We could not find any peer-reviewed scientific evidence to support the use of any other botanicals as repellents in malaria/dengue areas; including oils of castor, soybean, citronella, neem, cedar, clove, geraniol, lemongrass, peppermint or rosemary [12][19][20].

- **Non-DEET Synthetic Repellents**
  - Picaridin (KBR 3023) – 10-20% suitable for 8 hours. NOT suitable for children under 3.
  - IR3535 – 10-20% suitable for 8 hours (may damage plastics).

### Summary of Mosquito Repellent Review

<table>
<thead>
<tr>
<th>Active Ingredient</th>
<th>Available Brands (NOT an endorsement)</th>
<th>Active Conc.</th>
<th>Effective Time (see label to confirm)</th>
<th>Age Limit</th>
<th>Effectiveness (on Aedes mosquitoes)</th>
<th>Approved By</th>
<th>Ref.</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEET</td>
<td></td>
<td>23.8%</td>
<td>480 minutes</td>
<td>&gt;12</td>
<td>100% Protection</td>
<td>WHO, EU, CDC, EPA</td>
<td>[9] [10] [16] [22]</td>
</tr>
<tr>
<td></td>
<td>OFF!, Soffel, Auran</td>
<td>13-15%</td>
<td>360 minutes</td>
<td>&gt;12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>OFF!</td>
<td>7.5%</td>
<td>120-180 minutes</td>
<td>&gt;2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4.75%</td>
<td>45-120 minutes</td>
<td>&gt;0.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oil of Lemon Eucalyptus</td>
<td>Mozi Guard</td>
<td>32%</td>
<td>180 minutes</td>
<td>&gt;3</td>
<td>95% Protection</td>
<td>EU, CDC, EPA</td>
<td>[10] [12] [9]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10%</td>
<td>120 minutes</td>
<td>&gt;3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Picaridin</td>
<td>Moskito Guard</td>
<td>20%</td>
<td>480 minutes</td>
<td>&gt;3</td>
<td>95% Protection</td>
<td>CDC, EPA</td>
<td>[2] [3] [9] [12]</td>
</tr>
<tr>
<td></td>
<td>Moz Away Junior</td>
<td>9-10%</td>
<td>240 minutes</td>
<td>&gt;3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IR3535</td>
<td>Pureen Rékito</td>
<td>20%</td>
<td>240-480 minutes</td>
<td>&gt;1</td>
<td>95% Protection</td>
<td>WHO, EU, CDC, EPA</td>
<td>[9] [16] [18]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7.5%</td>
<td>120 minutes</td>
<td>&gt;0.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Citronella</td>
<td></td>
<td>12%</td>
<td>1-55 minutes</td>
<td>&gt;3</td>
<td>20-90% Protection</td>
<td>EPA</td>
<td>[5] [16] [10] [19]</td>
</tr>
<tr>
<td>Soybean Oil</td>
<td></td>
<td>2.0%</td>
<td>90 minutes</td>
<td>&gt;0.5</td>
<td>20-90% Protection</td>
<td>None</td>
<td>[5] [16] [10] [19]</td>
</tr>
</tbody>
</table>

### What about other potential Repellents?

We found the following about other potential repellents:

- We could not find any evidence of the effectiveness of repellents contained in patches, battery powered clip-ons (with insecticide) and bands for your wrist, neck or ankles and so do not recommend their use (repellents only protect up to 4 cm from the site of application) [16].
- We have found no evidence that ingestion of garlic or Vitamin B1 provide any repellency [16].
- We also recommend that you don’t solely rely on mosquito coils by themselves, as they only provided minimal protection in a 2 metre radius, and only if there is no wind [4] [13].
- Sunscreen or moisturisers combined with repellents are also not recommended [12].
References

[13] WHO: http://apps.who.int/medicinedocs/fr/d/Js2255e/1.3.html
[21] Baby Centre: http://www.babycenter.com/0_test-your-health-iq-which-bug-repellents-are-safe-for-your-t_1242550.bc
[26] Women and Mosquito Repellents, with their active ingredient: http://www2.epa.gov/insect-repellents/skin-applied-repellent-ingredients
[27] EPA DEET Summary [The risk of seizures associated with DEET was related to ingestion and incorrect application, and was estimated by the EPA to occur in one per 100 million users - you are significantly more likely to be struck by lightning!]: http://www.epa.gov/teach/chem_summ/DEET_summary.pdf