

## AN OVERVIEW OF INSECT REPELLENTS

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### ABSTRACT

Insect repellents are essential in the fields of public health and outdoor activities as they are designed to combat the constant danger posed by biting insects. These medications function as an initial barrier against insect-borne infections, including prominent ones such as malaria, Zika virus, West Nile virus, and Lyme disease. Repellents contain active compounds that prevent insects, making them crucial for global health, particularly in places where these diseases are prevalent. In addition to preventing diseases, insect repellents can soothe the discomfort caused by bug bites, offering relief from itching, swelling, and potential allergic reactions. The wide range of application methods allows individuals to easily integrate repellents into their regular routines or specific outdoor activities, accommodating various tastes and requirements. Furthermore, repellents offer substantial advantages to vulnerable populations, such as pregnant women and small children, by providing a strong protective barrier. The economic ramifications are significant, as the extensive utilization of repellents contributes to enhanced public health results and perhaps reduces healthcare expenses linked to the treatment of insect-borne illnesses. The development of eco-friendly repellents has been driven by environmental concerns, demonstrating an understanding of the intricate relationship between personal health and environmental sustainability. The ongoing progress in research and development is driving the continuous improvement of repellents, guaranteeing their efficacy, safety, and applicability in response to new difficulties. Essentially, insect repellents are essential tools for promoting a healthier and more comfortable coexistence with insects.

**Keywords:** Allergy, Bug bites, DEET, Eco-friendly repellants, Insects

### INTRODUCTION

Insect repellents play a vital role in safeguarding individuals from the nuisance and potential health risks posed by biting

insects. Arthropods not only cause significant damage to food crops, but they also can consume the blood of humans and other animals (Chinthaka et al., 2023). By doing this, they possess the capacity to

spread diseases and leave allergic compounds on the skin. Arthropods exhibit a vast range of species and could be classed as pests. An insect bite has the potential to generate a life-threatening infection at its most severe (Mangang et al., 2023). Although bites can be a mild discomfort in some circumstances, they can also be fairly painful. Possible strategies for mitigating agricultural damage or bug bites involve managing arthropod populations by the use of insecticides, eliminating breeding grounds, or using measures to alter arthropod behavior (Almeida, et al., 2023). These chemical-based treatments, often known as insect repellents, are frequently used for personal protection. They function as a protective mechanism against vectors or bothersome insects that come into contact with humans.

These formulations, often available in various formats such as sprays, lotions, and wipes, are designed to deter insects from landing on exposed skin or clothing. The active ingredients in these repellents, such as DEET, picaridin, and oil of lemon eucalyptus, create a protective barrier, reducing the likelihood of insect bites (Dehghanizadeh et al., 2023). The use of insect repellents is not only confined to outdoor enthusiasts exploring diverse environments but extends to everyday activities, offering a shield against

mosquitoes, ticks, fleas, chiggers, and other biting insects. This introduction sets the stage for an exploration of the multifaceted uses, benefits, and considerations associated with insect repellents, emphasizing their pivotal role in promoting both health and comfort, particularly in regions where insect-borne diseases are prevalent (Bauer, et al., 2023).

The flexibility in application methods, such as sprays, lotions, creams, and wipes, ensures that users can choose a format that aligns with their preferences and comfort. Insect repellents are designed to ward off a broad spectrum of insects, ranging from mosquitoes and ticks to fleas, chiggers, and biting flies, making them versatile for various outdoor environments (Fulton, et al., 2023). For those who prefer alternative methods, insect repellents offer options such as treating clothing or using natural repellents like essential oils. This not only caters to personal preferences but also promotes eco-friendly alternatives, with some repellents designed to minimize environmental impact. Ultimately, the use of insect repellents provides peace of mind, knowing that proactive measures have been taken to reduce the risk of insect bites and the associated consequences (Higuchi, et al., 2023). To maximize the benefits, it is crucial to adhere to product instructions, consider individual sensitivities, and

remain mindful of any safety considerations. Thus, insect repellents contribute significantly to creating a safer and more enjoyable outdoor environment for individuals of all ages (Sukrutha, et al., 2023).

Insect repellents offer a myriad of benefits, primarily centered around protecting against the nuisance and potential health risks associated with insect bites (Paul, et al., 2023). One of the foremost advantages is the prevention of diseases transmitted by insects, such as malaria, Zika virus, West Nile virus, and Lyme disease. Active ingredients like DEET, picaridin, and oil of lemon eucalyptus act as a barrier, deterring insects from landing on exposed skin and reducing the risk of infection (Lawrence, et al., 2023). Beyond disease prevention, insect repellents alleviate discomfort caused by itching, swelling, and irritation resulting from insect bites, promoting a more pleasant outdoor experience.

### 1.1 Chemistry of insect repellents

Understanding the chemistry of these repellents allows users to make informed choices based on their specific needs, preferences, and environmental considerations (de Barcelos, et al., 2023). Advances in research continue to explore new compounds and formulations, aiming

to enhance the effectiveness and safety of insect repellents while addressing emerging challenges, such as insect resistance and environmental impact (Patel, et al., 2023). As individuals navigate various outdoor settings, a nuanced understanding of the chemistry behind these repellents ensures a more tailored and effective approach to insect bite prevention. The chemistry of insect repellents involves a diverse array of compounds designed to interfere with the sensory mechanisms of biting insects (Turan et al., 2023).

The chemistry of these repellents is designed to either interfere with the insect's ability to detect human scents or act as a contact insecticide (Rehman, et al., 2023). The choice of repellent depends on factors such as the type of insects in the area, the duration of protection needed, and individual preferences. It's essential to follow product instructions for proper application and to consider any safety precautions associated with the specific active ingredient used.

#### **DEET (N,N-Diethyl-meta-toluamide)**

DEET is a synthetic compound with a chemical formula of  $C_{12}H_{17}NO$ . DEET works by interfering with the insect's ability to locate humans through their sense of smell. It masks the scent of carbon dioxide

and lactic acid, which are indicators of human presence (Liggri, et al., 2023).

**Picaridin (Icaridin)** Picaridin, also known as KBR 3023, has the chemical formula  $C_{12}H_{23}NO_3$ . Picaridin disrupts the insect's ability to locate its target by blocking the receptors that are sensitive to human odors (Paudel et al., 2023). It provides effective protection against mosquitoes, ticks, and flies.

#### **IR3535 (Ethyl Butyl acetyl amino propionate)**

IR3535 has the chemical formula  $C_{12}H_{23}NO_2$ . IR3535 works by interfering with the insect's antennae receptors, confusing their ability to recognize human scents (Nguyen et al., 2023). It is effective against a range of insects, including mosquitoes and ticks.

**Citriodiol** Oil of Lemon Eucalyptus is a natural oil extracted from the lemon eucalyptus tree (*Corymbia citriodora*). The main active component, p-menthane-3,8-diol (PMD), acts as a repellent by masking human odors and making it difficult for insects to locate their target (Gibson, et al., 2023).

**Citronella** Citronella is an essential oil extracted from various species of Cymbopogon grasses. Citronella disrupts the ability of insects to locate humans by

masking scents that(Kowalewski et al., 2023). It is commonly used in candles, lotions, and sprays.

**Permethrin** Permethrin is a synthetic pyrethroid with the chemical formula  $C_{21}H_{20}C_{12}O_3$ . Permethrin acts as a contact insecticide and repellent. When applied to clothing, it repels and kills insects on contact.

### **1.2 Mechanism of action of insect repellents**

The primary objective of these repellents is to discourage insects from landing on or biting humans. Insect repellents function through various mechanisms to deter or prevent insects, primarily mosquitoes, from landing on or biting individuals (Yunos et al., 2024).

#### **Interference with insect's olfactory receptors**

One common mechanism involves the interference with the insect's olfactory receptors, disrupting their ability to locate potential hosts (Daftary et al., 2023). Many repellents contain compounds such as DEET (N, N-Diethyl-meta-toluamide) or picaridin, which create an olfactory barrier that confuses the insects, making it difficult for them to detect the scent of humans (Sharma, et al., 2023). It confuses their olfactory receptors, making it challenging

for them to detect the carbon dioxide, heat, and sweat that usually attract mosquitoes to their hosts.

### **Masking the human scent**

Another approach involves masking the human scent altogether by producing an odor that is unappealing or overwhelming to the insects. Some natural repellents, like citronella or eucalyptus oil, fall into this category (Luker, et al., 2023). These natural repellents create an environment that is unappealing to insects, thus reducing the likelihood of bites.

### **Interfering with insect's nervous system**

Additionally, certain repellents work by affecting the insect's nervous system, causing discomfort upon contact, and thereby discouraging them from landing (Atkovska, et al., 2023). These repellents often contain ingredients like permethrin, which, when applied to clothing, creates a barrier that repels and kills insects on contact.

## **1.3 Myriads of Benefits**

Insect repellents serve a multitude of purposes, making them indispensable for individuals venturing into areas with high insect activity (Chibi, et al., 2023). One primary use is the prevention of insect-borne diseases, as repellents create a protective barrier against mosquitoes, ticks,

and other disease-carrying insects. This is particularly crucial in regions where illnesses such as malaria, Zika virus, and Lyme disease are prevalent. Repellents also play a significant role in reducing discomfort by preventing itchy and irritating insect bites, allowing individuals to enjoy outdoor activities without the constant distraction of swarming insects (Torres, et al., 2023).

Moreover, insect repellents offer protection for vulnerable populations, including pregnant women and young children, who may be more susceptible to the effects of insect bites. The flexibility in application methods, such as sprays, lotions, and wipes, ensures that users can easily incorporate repellents into their routine, adapting to different preferences and comfort levels (Li, et al., 2023). Outdoor enthusiasts benefit from the versatility of repellents, which effectively deter a wide range of insects like mosquitoes, ticks, fleas, chiggers, and biting flies, catering to various outdoor environments and activities.

For those concerned about allergic reactions to insect venom, repellents act as a preventive measure, minimizing the risk of severe responses (Champakaew et al., 2023). Additionally, the use of insect repellents provides peace of mind, instilling

confidence in individuals that they have taken proactive steps to safeguard themselves against insect-related risks. Lastly, some repellents are available in eco-friendly formulations, addressing environmental considerations for users who prioritize sustainability. In summary, the diverse uses of insect repellents encompass health protection, comfort enhancement, adaptability, and environmental consciousness, making them an essential tool for anyone spending time outdoors (Mishra, et al., 2023).

Insect repellents offer a comprehensive array of uses that extend beyond mere protection from insect bites. Their primary role in preventing the transmission of diseases, especially in regions where insect-borne illnesses are endemic, underscores their global significance. Mosquitoes, acting as vectors for diseases like malaria, dengue fever, and Zika virus, make repellents an essential tool for public health (Kamara et al., 2023). Insect repellents offer a range of benefits, primarily focused on protecting individuals from insect bites and the potential health risks associated with such bites. Here are several benefits of using insect repellents:

**Disease Prevention:** Insect repellents, especially those containing active ingredients like DEET, picaridin, or oil

of lemon eucalyptus, provide a crucial line of defense against insects that may carry diseases such as malaria, Zika virus, West Nile virus, Lyme disease, and more. By preventing insect bites, repellents contribute to reducing the risk of contracting these illnesses (Iovinella et al., 2023).

**Reduced Discomfort:** Insect bites can cause itching, swelling, and discomfort. Repellents help minimize these effects by preventing insects from landing on and biting exposed skin.

**Outdoor Enjoyment:** Insect repellents enable individuals to enjoy outdoor activities without constant interruptions from biting insects (Wong, et al., 2023). Whether camping, hiking, gardening, or participating in sports, repellents help create a more pleasant outdoor experience.

**Protection for Vulnerable Populations:** Certain populations, such as pregnant women and young children, are more susceptible to the effects of insect bites (Pan et al., 2023). Repellents, when used according to guidelines, can provide protection for these vulnerable groups.

**Prevention of Allergic Reactions:** Some individuals may be allergic to

insect bites, and severe reactions can occur. Repellents act as a preventive measure, reducing the likelihood of allergic responses to insect venom (Deng et al., 2023).

**Flexibility in Application:** Insect repellents come in various forms, including sprays, lotions, creams, and wipes, providing users with flexibility in choosing the application method that suits their preferences and comfort.

**Protection Against a Variety of Insects:** Repellents are designed to deter a broad spectrum of insects, including mosquitoes, ticks, fleas, chiggers, and biting flies. This versatility makes them valuable in diverse outdoor environments (Rajput, et al., 2023).

**Alternative to Chemical-Free Methods:** For those who prefer not to use chemical repellents, there are alternative methods such as treating clothing, wearing protective clothing, or using natural repellents like essential oils.

**Peace of Mind:** Using insect repellent can provide peace of mind, especially in regions where insect-borne diseases are prevalent (Marsin, et al., 2023). Knowing that you have taken steps to

minimize the risk of insect bites can enhance your overall outdoor experience.

**Environmental Considerations:** Some repellents are available in eco-friendly formulations, considering the environmental impact (Gupta, et al., 2023). This allows users to protect themselves without compromising their environmental values.

#### 1.4 Eco-friendly Insect repellents

Natural insect repellents offer an alternative to chemical-based options, often utilizing plant-derived compounds with insect-repelling properties. Some of the commonly used natural repellents include:

**Citronella Oil:** It is extracted from lemongrass (*Cymbopogon nardus*) and citronella plants. It masks scents that attract insects and acts as an irritant to mosquitoes (Amane et al., 2023). It is generally found in candles, sprays, and lotions.

**Lemon Eucalyptus Oil:** It is extracted from the lemon eucalyptus tree (*Corymbia citriodora*). It contains citronellal, a compound that repels insects. It is generally available in sprays and lotions, and is very effective against mosquitoes.

**Peppermint Oil:** It is derived from the peppermint plant (*Mentha piperita*) and repels insects with its strong scent (Zhang et al., 2023). It is often combined with other oils in sprays and lotions.

**Tea Tree Oil:** It is extracted from the leaves of the tea tree (*Melaleuca alternifolia*). It has possessed antimicrobial properties and acts as an insect repellent; therefore it is found in various natural repellent formulations (Ogilvie-Battersby, et al., 2023).

**Neem Oil:** It is extracted from the neem tree (*Azadirachta indica*). It acts as an insect growth regulator and disrupts feeding patterns. Neem oil is applied topically or mixed with other oils.

**Lavender Oil:** It is derived from lavender flowers (*Lavandula angustifolia*). It is known for its calming scent; which repels mosquitoes and other insects (Le, et al., 2023). Lavender Oil is found in sprays, lotions, and as a plant deterrent.

**Cinnamon Oil:** The strong scent of *Cinnamon* that disrupts insects' communication and navigation, is extracted from cinnamon bark (*Cinnamomum zeylanicum*). It is

generally combined with other oils or diluted for skin application (Feng, et al., 2023).

**Clove Oil:** Clove oil contains eugenol extracted from clove buds (*Syzygium aromaticum*). It is often combined with carrier oils for skin application (Koinari et al., 2023).

## CONCLUSION

An insect repellent is a substance that is applied to the skin, clothing, or other surfaces to discourage insects and other arthropods from landing or moving on those surfaces. Insect repellents help to prevent and manage the occurrence of diseases transmitted by insects and other arthropods. Common vectors for disease transmission are pest animals, including insects such as fleas, flies, and mosquitoes, as well as ticks (arachnids). Although some insect repellents have insecticidal properties, meaning they can kill insects, most just act as deterrents, causing insects to fly or crawl away. Any drug that reaches the median lethal dose would be fatal, but being categorized as an insecticide implies that even lower quantities can cause death. Ongoing research on the mechanism of action of insect repellents is providing new knowledge for the discovery and development of future active compounds. These innovative components seek to



disrupt insect behavior while circumventing the disadvantages linked to

the current array of repelling artificial intelligence.

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**Table 1: Various Aspects of Insect Repellents**

ASPECT	INFORMATION
<b>Active ingredients</b>	DEET (N,N-Diethyl-meta-toluamide), picaridin, IR3535, and oil of lemon eucalyptus are common active ingredients. Each has unique properties and effectiveness against different insects.
<b>Duration of protection</b>	DEET is known for its long-lasting effect. Higher concentrations provide extended protection. Duration varies among repellents and concentrations.
<b>Application</b>	Repellents can be applied directly to the skin or clothing. Available in various formulations: sprays, lotions, creams, wipes. Follow product instructions for proper application.
<b>Clothing treatment</b>	Some repellents are designed for treating clothing, creating a barrier against insects. Follow product guidelines for proper application to enhance overall protection.
<b>Effectiveness against specific insects</b>	Different repellents may vary in effectiveness. Consider local insect populations and diseases when choosing a repellent.
<b>Safety considerations</b>	Be mindful of potential allergic reactions. Pregnant women and young children may have specific usage recommendations. Follow product safety guidelines on the label.
<b>Environmental impact</b>	Some repellents, like DEET, may have environmental impact. Consider biodegradable and eco-friendly options for those concerned about the ecological footprint.
<b>Alternative methods</b>	Besides chemical repellents, alternative methods include wearing long-sleeved clothing, using mosquito nets, and avoiding peak mosquito activity times.

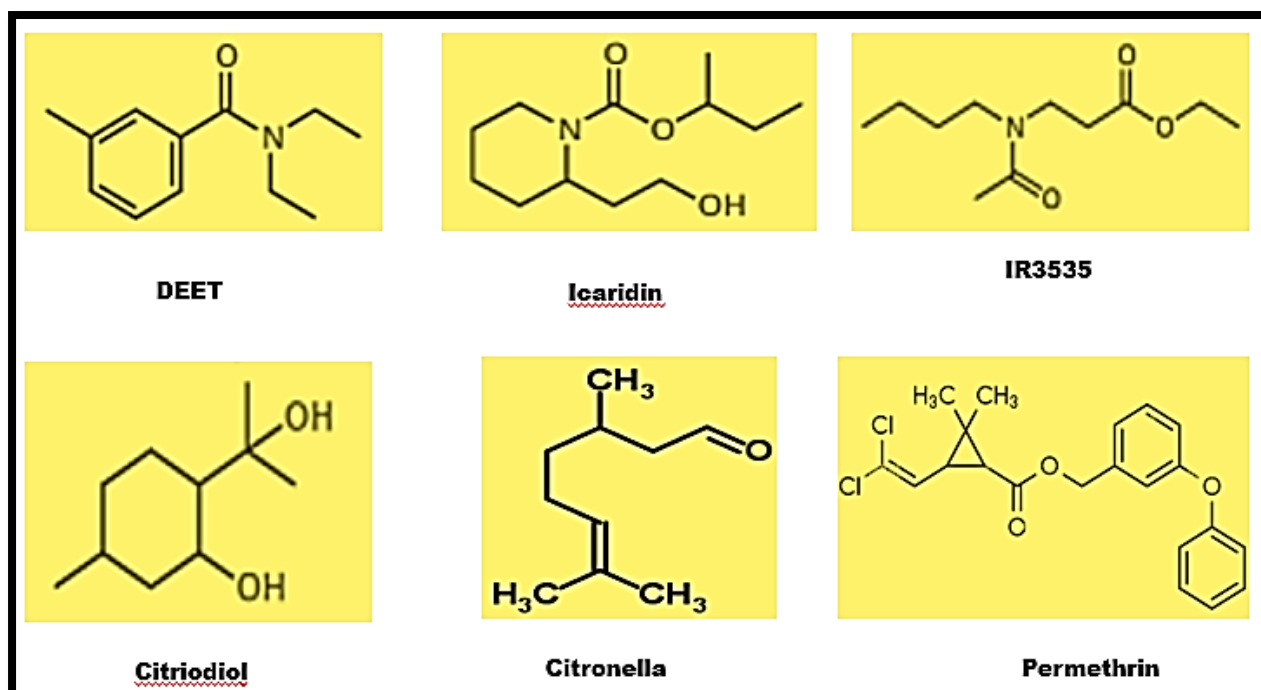


Figure 1: Chemical Structure of Insect Repellents