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Comparative Studies of Herbal Drug (Citronella Leaf) with Synthetic Mosquito Repellent

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ABSTRACT

All over the developing countries mosquito menace has been leading to many diseases. Carbon dioxide and lactic acid present in human sweat severe as an attractive substance for mosquito. The perception of odour is through chemoreceptors present in the antennae of mosquitoes. Repellent blocks the activity of chemoreceptors and makes the mosquito blind and kill them. Many synthetic repellents have been introduced and used; however, they are harmful to human health. Recently, many plant-based repellents have been used and gained popularity among consumers. Plant-based mosquito repellent is 'safe' to use in comparison to synthetic repellent, as synthetic repellent causes many problems such as rashes, skin irritation and it is carcinogenic. Hence, it is studied that natural i.e. plant-based repellents are non-toxic and safer, so it is preferred over synthetic repellent.

INTRODUCTION

In all tropical and subtropical countries, mosquito-borne disease is a major human and animal health problem [1]. Lactic acid and carbon dioxide present in the sweat of warm-blooded animals act as an attractive substance for mosquito [2]. Mosquitoes transmit many diseases such as haemorrhagic fever, filariasis, yellow fever, malaria, a different form of encephalitis, and dengue [3]. Malaria kills 3 million populations each year, including one child every 30 seconds [4]. DEET (N, N- diethyl-3-methylbenzamide) is a synthetic mosquito repellent used by billions of people worldwide. It shows more toxicity against skin usually when the synthetic repellent is used for a long time or used incorrectly [5]. The repellent product use for control of mosquito has several degrees of effectiveness but many people still hate the smell of mosquito coil which contains synthetic Pyrethroid when it burns, and thus people feel that the coil may be hazardous for their health [6]. Mosquito repellent based on chemical substance do not have a remarkable safety profile, as they are toxic against the nervous system and skin which may cause swelling, rashes, eye irritation, and other skin problems, along with unusual swelling in the brain especially in children, low blood pressure and anaphylactic shock. Hence, natural mosquito repellent is more preferred over synthetic mosquito repellent [6]. The benefits of the natural product include effective control of mosquito as well as environmental safety. In the present scenario controlling mosquito is of utmost importance with the increasing number of mosquitoes-borne diseases [7]. Many herbal and herbivores plants have evolved fragrances that repel mosquito along with making essential oil extracted from plants for anti-mosquito material. Citronella oils and eucalyptus oil are well registered natural substances which have been proved to be efficient mosquito repellents [8].

Methods to control mosquitoes

Mosquito-borne diseases affect millions of people worldwide each year. Mosquito bites are dangerous and harmful to humans. Female mosquitoes bite humans to consume blood. Mosquito bites can cause skin irritation and swelling. Mosquito bites also transmit some extremely harmful and sometimes fatal diseases such as malaria, dengue, fever, and yellow fever. Mosquitoes are not just a nuisance, but also potentially they are harmful. By taking precautions such as wearing long pants, wearing long gloves in hand in wooded areas, or disposing of standing water, we can minimize the risk of attracting mosquitoes. These measures are often not enough and special products like mosquito repellent must be used to

combat mosquitoes. Each of the products has various degrees of efficacy, effectiveness and it is very important to know that some may be better than others [9].

Classification of mosquito repellents

1. Chemical methods:
    A. Synthetic repellents e.g. DEET, permethrin
    B. Natural repellents e.g. Citronella oil, Tulsi oil, Neem oil, etc
2. Non chemical methods:
    A. Physical method:
        a. Medicated net
        b. Non medicated net
        c. Mosquito traps
    B. Mechanical methods:
        a. Electric mosquito zapper
        b. Mosquito magnet
3. Biological methods:
    By growing some fish species that feeds on mosquito larvae in the water bodies

Mechanism action of mosquito repellents

Carbon dioxide, excretory products and lactic acid present in sweat in warm-blooded animals act as an attractive substance for female mosquitoes. The perception of the odour is through chemoreceptors present in the antennae of mosquitoes. The repellents block the lactic acid receptors thus destroying upwind flight and as a result, the mosquitoes lose its contact with the host. Usually, insect repellents work by masking human scent, or by using a scent which insects naturally avoid. Permethrin is different in that it is a contact insecticide.

A. Synthetic repellents

Many synthetic repellents are used to repel or control the mosquitoes such as DEET, permethrin, picaridin, IR3535, etc. N, N- Diethyl- meta- toluamide also known as DEET or diethyltoluamide widely used in many formulations as a mosquito repellent due to its effectiveness and high efficacy.

DEET is the most common ingredient used in many mosquito repellent formulations. It is a slightly yellow oil that is intended to be applied to the skin or on to the cloth and it protects against mosquitoes, flies, ticks, and many other biting insects.

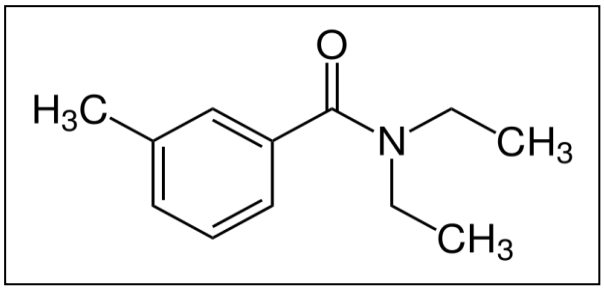

Figure No.1: Structure of DEET [10]

How DEET works on mosquito

DEET does not kill mosquitoes it deters and repels them. DEET blocks the insect olfactory receptors for 1- octane- 3- ol. 1- octene- 3- ol is a volatile substance that is present in human sweat and human breath. DEET effectively 'blinds' or 'confuse' the insect's senses so that the biting/feeding instinct is restricted and it is not triggered by the chemicals such as lactic acid and carbon dioxide present in humans. In the absence of body odour attractants such as 1-octan- 3- ol, lactic acid, or carbon dioxide DEET act as a strong repellent [11] [12].

The concentration of DEET in products may range from 10% - 100%. 10%- 30% concentration is recommended for children and infants. Do not apply to children under 2 months of age and do not apply products containing more than 30% DEET on children [13]. Products containing 100% concentration of DEET can offer up to 12 hours of protection whereas lower concentrations such as 20-30% offered up to 3-6 hours of protection.

Talking about mosquito coil

Mosquito coil is known as an efficient mosquito repellent. The common and major ingredients used in mosquito coil is pyrethrin's, accounting for about 0.3- 0.4% of coil mass. When a mosquito coil is burned, the smoke of the coil evaporates which prevents the entry of mosquito into the room. But the gas phase which is produced from the smoke contains some carbonyl compounds with properties that can produce strong irritating effects on the respiratory tract, for example, formaldehyde and acetaldehyde. Mosquito coil measures around 15 centimetres, 6 inches in diameter and stays last around 7- 12 hours.

Some of the ingredients used in mosquito coil

Pyrethrum- A natural, powdered material from a kind of chrysanthemum plant.

Pyrethrin-An extract of the insecticidal chemicals in pyrethrum.

Allethrin-Sometimes d- trans- allethrin, the first synthetic pyrethroid.

BHT- An optional additive used to prevent pyrethroid from oxidizing during burning.

Mostly traditional coils and sticks are made up of pyrethrum pastes, modern mosquito coils contain either pyrethroid insecticides or plant-based substances such as citronella. Pyrethroid containing as a mosquito repellent in mosquito coil is toxic to humans and the environment but effective in reducing mosquito. Citronella containing as a mosquito repellent in mosquito coil is cheap, safe, and portable, it contains an aromatic substance that repels mosquitoes or reduces the mosquito.

Effect of mosquito coil on health

- The coil contains pyrethroid, pyrethrum, and allethrin which is a toxic substance used for the control of flies and mosquitoes.
- Allethrin is not good for human health due to its toxic nature.
- The tiny smoke being produce by mosquito coil is not well guarded and attended which could lead to fire out in our homes and could cause damage.
- The area which is not well ventilated could trigger some respiratory conditions such as asthma as the smoke tends to fill the room.
- Mosquito coil is equivalent to roughly smoking over 100 sticks of cigarettes.
- It is carcinogenic, specially leads to lung cancer.
- Major cause is cough and skin irritation, throat discomfort.
- Allethrin contains Type 1 pyrethroid which contains a cyano group and cause repetitive discharge in nerve fibre and hyper excitation. Type 2 pyrethroid which cause nerve membrane repolarization and blocks leading to paralysis.
- Pyrethroid decreases the antioxidant level and produces oxidative stress.
- Mosquito coil smoke can cause chromosomal change in bone marrow.

Advantages of synthetic mosquito repellent: -

1. It contains DEET and picaridin are more effective than repellent with the natural active ingredient.

2. It gives effectiveness for the first 2 hours, where the natural repellent gives the first 30-60 minute [14].

Disadvantages of synthetic mosquito repellent: -

1. It may cause rashes, swelling, eye irritation, brain swelling in children, low blood pressure, and anaphylactic shock.

2. Synthetic mosquito repellent must be used with caution especially with children.

3. It may cause dizziness and severe irritation in the skin.

4. It may cause a carcinogenic effect [15].

A. Natural repellents

Citronella is herbal and a natural repellent used widely as a mosquito repellent. The name Citronella is derived from the French word "Citronelle" in 1858 & it was mostly used for perfumery. An Indian Army personnel used it to repel mosquitoes at the beginning of the 20th century, later it was registered for commercial use in the USA in 1948. Today, 5-10% conc. Citronella is one of the widely used natural repellents in the market. Higher concentrations can cause skin sensitivity. However, there are relatively few studies that determine the efficacy of essential oils from citronella as arthropod Citronella repellents. Formulation of the repellent is very important as Citronella-based repellents only protect from host-seeking mosquitoes for about two hours. Initially, citronella, which contains citronellal, citronellol geraniol, citral, a-pinene, and limonene, is as effective dose as DEET, but the oils rapidly evaporate causing loss of efficacy and leaving the user unprotected [16].

Oil is colorless or light-yellow liquid with a characteristic woody, grassy, or lemon odour [17]. Citronella was originally extracted for use in the perfume industry and its derived from French citronella around 1858. Citronella oil is an herbal or natural, non-toxic alternative to chemical mosquito repellent such as DEET, therefore is usually preferred first [18].

It is commonly assumed that plant-based repellents are safer than DEET because they are natural. The demand for plant-based repellents is growing exponentially as consumers demand means of protection from arthropod bites that are safe, pleasant to use, and environmentally sustainable. Improving the longevity of those repellents that are effective but volatile such as citronella should be the most important consideration [8]. It is also presumed that plant-based repellents are better for the environment than synthetic molecules.

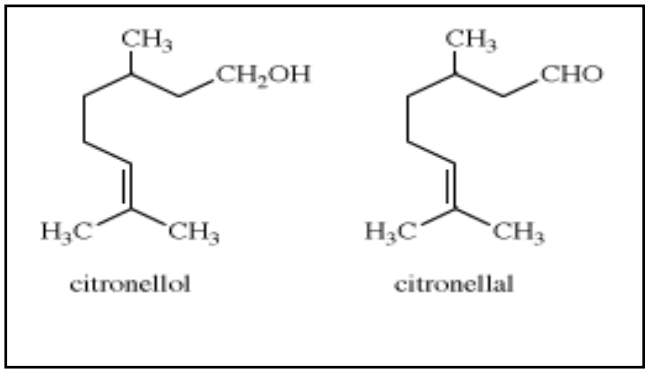

Figure No. 2: Structure of Citronella [18]

Advantages of natural mosquito repellent: -

1. Non-toxic.

2. Nonsticky and environmentally friendly.

3. Safer on sensitive skin and can be used on children as young as 3 months.

4. Reduced irritation.

5. Harmless to most plastic and fiber.

6. They are friendly and kind on sensitive skin.

7. By combine different natural mosquito repellent they work better than any DEET repellent [14].

Disadvantages of natural mosquito repellent: -

1. More expensive.

2. Natural repellent can be short-lived in their effectiveness [14].

Figure No.3: Citronella Leaf [19]

Figure No.4: Mosquito Coil [20]

Table 1.1- List of drugs used in herbal medicines [21]

SR. NO	Name of the plant species	Vern name (Assamese)	Parts used
1	Homoamino aromatica (Roxb.) Schott	Gonkochu	Dry rhizome
2	Ocimum basilicum L.	Bon-tulsi	Bon-tulsi
3	Ageratum conyzoides L.	. Gendhali bon	Whole plant
4	Litsea glutinosa (Lour.)	C.B. Robins	Baghnol Bark

CONCLUSION

From the above study, it is concluded that the natural repellent is best and safe as compared to the synthetic repellent. As synthetic repellent has various side-effects on humans such as rashes, irritation, low blood pressure, etc. So, the demand for natural mosquito repellent has been increasing day by day. Natural mosquito repellents eco-friendly and when combining with two or more natural-based ingredients together it works effectively than the synthetic repellent. Plant-derived repellents do not cause toxicity to humans and are easily biodegradable. Compared to synthetic compounds, natural products are presumed to be safer for human use.

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