

Formulation and Evaluation of Mosquito Repellent Dhoop from *Jatropha Integerrima*

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Abstract- Use of Mosquito Dhoops: A Comparison of Chemical Composition and Indoor Air Quality to Other Mosquito Control Methods. Mosquito dhoops are commonly used household insect repellent and have been proven effective at helping to reduce the spread of mosquito-borne diseases such as Malaria and Dengue by controlling mosquito populations. In this study, we will examine several aspects of mosquito dhoops including their composition, active ingredients (pyrethroids and plant derived), and how they work as a repellent and/or killing insects, the effect they have on air quality parameters (particulate matter and toxic emissions) through the process of combustion.

The natural incense product known as herbal mosquito repellent dhoop is composed of plant-based ingredients to deter mosquitoes naturally instead of using strong chemical-based products. This product will be in a solid or powder form but all require ignition to release the smoke containing the natural herbal oils from neem, tulsi, citronella, lemongrass and eucalyptus that have properties repugnant to mosquitoes thus reducing the amount of them in either enclosed or semi-enclosed environments.

Keywords: Mosquito repellent, Dhoopana, Herbal material.

Mosquitoes are not just a nuisance but also carry serious diseases like malaria, dengue and chikungunya. The application of chemical mosquito repellents is common and there are concerns about the possible adverse effects on human health and the environment. Most traditional repellents release toxic fumes that can cause breathing problems, skin irritation and long-term health problems if you're exposed to them on a regular basis. There is a growing interest in natural and eco-friendly alternatives in recent years.

The use of herbal dhoop, which is traditionally used in the houses for religious and aromatic purposes, has emerged as a promising solution. Herbal dhoop as a mosquito repellent is a combination of traditional knowledge and the modern need for safer living spaces. It provides an inexpensive, biodegradable and sustainable method of mosquito control; while simultaneously creating a pleasant and calming environment. The objective of this study is to investigate the efficacy, benefits and possible uses of herbal dhoop as a natural mosquito repellent which can be used effectively for the reduction of aero microflora count.

What is Herbal Dhoop?

The formulation was prepared using natural ingredients like cow dung, cow milk, clarified butter and some herbs which are traditionally known for their fragrances. Cow dung has been used as a source of disinfection in different households since time immemorial. [1]

Air purification with herbal products is a good step, which not only purifies the air but also improves the atmosphere with pleasant fragrances. This is in line with the desire for a more natural and pleasant way to create a good indoor environment. [2]

It is traditionally burned to produce fragrant smoke used for religious, aromatic or medicinal purposes. Herbal Dhoop is free from harmful substances and eco-friendly unlike chemical based products. The smoke coming out of herbal dhoop repels insects like mosquitoes. This is a safe and natural way to maintain a clean and pleasant environment.

PHARMACOGNOSTICAL STUDY

Herbs Used In Dhoop Preparation:

1. JATROPHA INTEGERRIMA



Fig 4.1 Jatropha Integerrima

Scientific classification of Jatropha Integerrima

- ❖ Kingdom – Plantae
- ❖ Clade – Tracheophytes (vascular plants)
- ❖ Clade – Angiosperms (flowering plants)
- ❖ Clade – Eudicots
- ❖ Order – Malpighiales
- ❖ Family – Euphorbiaceae
- ❖ Genus – *Jatropha*
- ❖ Species – *Jatropha integerrima*

2. TULSI



Fig 4.2 Tulsi

Scientific classification of Tulsi

- ❖ Kingdom – Plantae
- ❖ Clade – Tracheophytes (vascular plants)
- ❖ Clade – Angiosperms (flowering plants)
- ❖ Clade – Eudicots
- ❖ Order – Lamiales
- ❖ Family – Lamiaceae (mint family)
- ❖ Genus – *Ocimum*
- ❖ Species – *Ocimum tenuiflorum*

3. NEEM



Fig 4.3 Neem

Scientific classification of Neem

- ❖ Kingdom: Plantae
- ❖ Clade: Tracheophytes (vascular plants)
- ❖ Order: Sapindales
- ❖ Family: Meliaceae
- ❖ Genus: *Azadirachta*

4. MINT



Fig 4.4 Mint

Scientific classification of Mint

- ❖ Kingdom: Plantae
- ❖ Clade: Tracheophytes (vascular plants)
- ❖ Order: Lamiales
- ❖ Family: Lamiaceae
- ❖ Genus: *Mentha*
- ❖ Species: *Mentha spicata* L. (Common mint / Spearmint)

5. LEMONGRASS



Fig 4.5 Lemongrass

Scientific classification of Lemongrass

- ❖ Kingdom: Plantae
- ❖ Clade: Tracheophytes (vascular plants)
- ❖ Order: Poales
- ❖ Family: Poaceae (Grass family)
- ❖ Genus: *Cymbopogon*
- ❖ Species: *Cymbopogon citratus* (DC.) Stapf (Common Lemongrass / West Indian Lemongrass)

6. EUCALYPTUS



Scientific classification of Eucalyptus

- ❖ **Kingdom:** Plantae
- ❖ **Clade:** Tracheophytes (vascular plants)
- ❖ **Order:** Myrtales
- ❖ **Family:** Myrtaceae (Myrtle family)
- ❖ **Genus:** *Eucalyptus*
- ❖ **Species:** *Eucalyptus globulus* Labill. (Tasmanian Blue Gum / Common Eucalyptus)

SELECTION OF MATERIALS

Selection of plants are based on their active chemical constituents

1) JATROPHA INTEGERRIMA

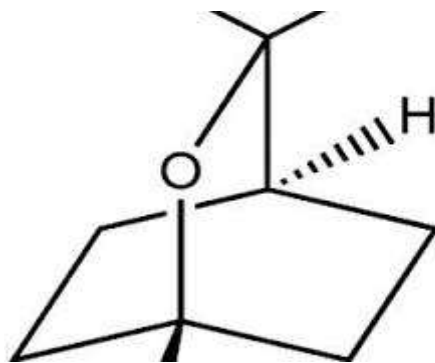


Fig 5.1 Cineole (Eucalyptol)

- ✓ **Molecular Formula-** C₁₀H₁₈O
- ✓ **Identification-** 1,3,3-trimethyl-2-oxabicyclo[2.2.2]octane
- ✓ **Molar Mass-** 154.25g/mol
- ✓ **IUPAC Boiling Point-** 176°C
- ✓ **Density-** 0.9225 g/cm³
- ✓ **Functional Group-** Cyclic Ether

Description:

Cineole also known as eucalyptol or 1,8-cineole is a natural monoterpenoid compound with the chemical formula C₁₀H₁₈O, commonly found in the essential oils of aromatic plants such as eucalyptus, rosemary and *Jatropha integerrima*. It is a colorless, volatile liquid with a strong, pleasant camphor odor.

2) TULSI

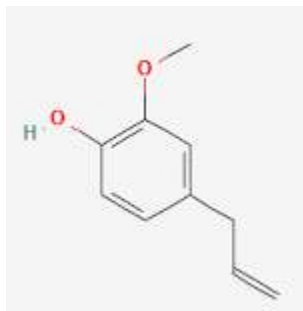


Fig 5.2 Eugenol

- ✓ **Molecular Formula-** C₁₂H₁₂O₂
- ✓ **IUPAC Name:** 4-allyl-2-methoxyphenol (or 2-methoxy-4-prop-2-enylphenol).
- ✓ **Molar Mass-** 164.204 g · mol
- ✓ **Boiling Point-** 264°C
- ✓ **Density-** 1.06g/cm³
- ✓ **Functional Group-** Phenolic Hydroxyl Group

Description:

Eugenol is a naturally occurring chemical compound found in plants such as Tulsi and cloves. It is a pale yellow liquid with a strong spicy odour similar to clove oil. Eugenol is really good at keeping insects. It does this by being an insect repellent. Eugenol also kills germs. Helps reduce pain. Eugenol has a strong smell. This smell confuses mosquitoes. Keeps them away from Eugenol. People use Eugenol in medicines. They use Eugenol in dental care. Eugenol is also used in food flavoring and, in perfumes

3) NEEM

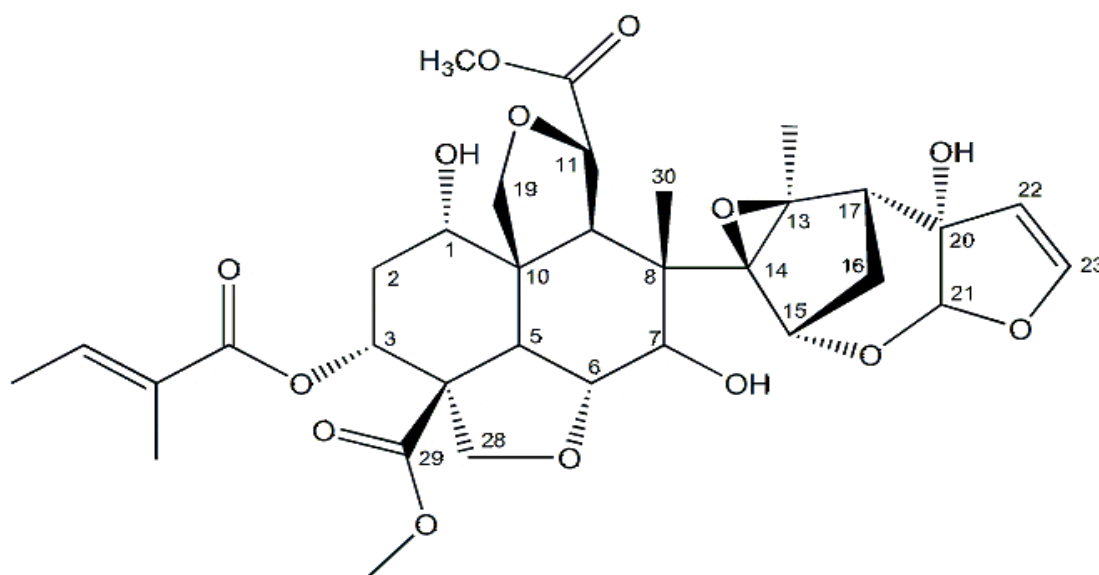


Fig 5.3 Azadirachtin

- ✓ **Molecular Formula-** $C_{35}H_{44}O_{16}$
- ✓ **IUPAC Name:** complex tetranortriterpenoid
- ✓ **Molar Mass-** $720.71 \text{ g}\cdot\text{mol}^{-1}$
- ✓ **Boiling Point-** Decomposes before boiling (not well-defined due to thermal instability)
- ✓ **Density-** $\sim 1.36 \text{ g/cm}^3$ (approximate)
- ✓ **Functional Group-** Ester, acetal, hydroxyl ($-\text{OH}$), and epoxide groups

Description

Azadirachtin is a natural chemical compound isolated from the seeds of the neem tree (*Azadirachta indica*). It is a member of a class of compounds known as tetranortriterpenoids and has potent insect-repellent and insect-growth-regulating activity.

When you use this method, it does not kill mosquitoes and other insects away. It works in a subtle way by messing with the hormones, inside the insects. This changes how mosquitoes and other insects grow how mosquitoes and other insects eat and how mosquitoes and other insects reproduce. After a while mosquitoes and other insects have a time eating properly and they are not able to grow into adults. This slowly reduces the number of mosquitoes and other insects.

4) MINT

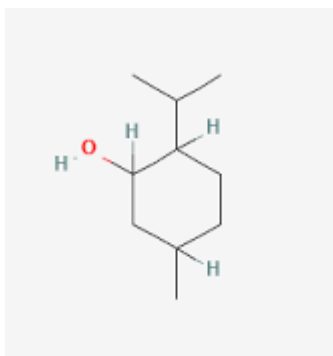


Fig 5.4 Menthol

- ✓ **Molecular Formula** – $C_{10}H_{20}O$
- ✓ **IUPAC Name** – 5-methyl-2-(propan-2-yl)cyclohexan-1-ol
- ✓ **Molar Mass** – $156.27 \text{ g}\cdot\text{mol}^{-1}$
- ✓ **Boiling Point** – $\sim 212^\circ\text{C}$
- ✓ **Density** – $\sim 0.89 \text{ g/cm}^3$
- ✓ **Functional Group** – Alcohol ($-\text{OH}$ group)

Description Mint, particularly peppermint, is a natural mosquito repellent due to its strong smell and essential oils. Menthol is the main compound responsible and other volatile compounds which insects find unpleasant.

Instead, all it does is keep mosquitoes Mosquitoes use their sense of smell to find humans. They get confused by the smell of mint. This makes it hard for mosquitoes to find what they are looking for. So, they stay away from places with mint. Mint actually keeps mosquitoes away from us.

EXPERIMENTAL WORK:

Material and equipment:

A. Plant material: Mint, Jatropha, Neem, Tulsi. were used for experimental pupose which was collected from Wadala, Dist. Solapur.

B. Chemical:

List of chemicals used in experimental pupose

Sr. No	Chemical	Company
1	Ethanol	Suyash Scientific Trader

C. Equipment:

List of equipment used for work

Sr. No	Equipment	Company
1	Soxhlet Apparatus	Labdhi Scientific co
2	Weighing Balance	Vigro
3	Heating Mantle	NS Metal Works

SELECTION TO EXTRACTION PROCESS OF PLANT MATERIAL:

A. Selection: Jatropha plant was selected by reviewing articles for its active mosquito repellent properties

Plant-



B. Collection: Leaves of *Jatropha*, was collected in April 2026 from Wadala Dist Solapur.



Fig 6.1 *Jatropha Integerrima*

C. Drying : Collected leaves were washed thoroughly to remove dirt, dust then shaded drying is done.



Fig 6.2 Collection

D. Weighing : Triturated powder is then weighed accurately for further extraction process.



Fig 6.3 Drying

E. Extraction of Plant Material:

Fresh leaves of *Jatropha Integerrima* were collected, washed thoroughly with distilled water to remove dust and impurities, and shade dried at room temperature for several days. The dried leaves were then powdered into a fine powder using a mortar & pestle. The powdered material was subjected to solvent extraction using ethanol by Soxhlet extraction method for 48–72 hours. The extract obtained was dried under shaded circumstances for further use.



Fig 7.1 Extraction

USES OF JATROPHA INTEGERRIMA

1. Fever and infections

The leaves of *Jatropha integerrima* retain a significant-inflammatory effect, both through oral administration and topical operation. This effect can be attributed to its high content of flavonoids, terpenoids, and oxygenated adipose acids, which are represented in the metabolomics profile of the excerpt by 65 composites. Our findings encourage farther disquisition of the rich metabolome of *J. integerrima* to identify new anti-inflammatory composites. [3]

2. Hepatoprotective Activity

Jatropha integerrima ply promising hepatoprotective eventuality against CCl₄ intermediated hepatotoxicity in rats. It was set up that the excerpt lowered the position of liver enzyme, increased the antioxidant status and lessened the histopathological revision presumably because of the high polyphenols and flavonoids present in the excerpt. [4]

Other Uses of **Mint**.

3. Gastrointestinal Diseases

The medical use of mints for gastrointestinal affections is present in the workshop of utmost proponents and croakers who came across them, from classical age to present- day drug. Mints have been constantly appertained to as enjoying anti-emetic and carminative parcels, and being used to grease digestion and help in the treatment of gastrointestinal diseases [5]

4. Iron deficiency

A state of veritably low haemoglobin content is known as iron insufficiency. Iron is a pivotal element for all living effects, including humans. Iron is vital to life because it can serve inversely well as an electron patron and acceptor. Heme is a prosthetic group that is generally set up in proteins and enzymes that contain iron. Heme is involved in a number of natural oxidations as well as transportation networks. Some essential proteins having performing iron include catalase, cytochrome, and haemoglobin [6]

5. Mint in Traditional Medicine

Traditional and folk drugs in Europe, China, Arabia, and the Indian key. The leaves are carminative and are used to treat digestive diseases similar as dyspepsia (e.g. discontinuous complaints of the upper gastrointestinal tract), bacillary dysentery, flatulence, gastritis, and enteritis. It's also used as a cholagogue, emmenagogue, vermifuge, to enhance lactation, and as a opiate. The leaves are useful in the treatment of bronchitis, diabetes, diarrhea, complications, hypertension, hostility, nausea, pain, respiratory, and urinary tract infections. [7]

6. Respiratory System

TRPA1 channels are susceptible to causing airway vexation if advanced attention of menthol are administered. A farther potentially adverse effect of menthol is that it increases mucus product, but also minimises mucus concurrence due to ciliary movement reductions. In clinical populations suffering from conditions that are associated with coughing e.g. COPD, this may be problematic as menthol may give respiratory relief, but further vitiate mucus concurrence [8]

FORMULATION TABLE 1

Sr. No	Ingredient Name	Quantity	Role
1	Cow dung powder	40 gm	Base, Slow burning
2	Neem powder	12 gm	Strong mosquito Repellent
3	Tulsi powder	6 gm	Repellent, anti- micro
4	Lemongrass powder	6 gm	Natural M. R
5	Jatropha Integerrima extract	4 gm	Active Repellent agent
6	Colophony	6 gm	Binding agent + improves burning

7	Beeswax	4 gm	Binding agent
8	Honey	3 gm	Natural Binder
9	Camphor	5 gm	Quick ignition
10	Eucalyptus oil	3 gm	Strong mosquito Repellent,
11	Clove oil	2 gm	Repellent, anti- micro
12	Lemon oil	2 gm	Repellent
13	Orange oil	1 gm	Fragrance
14	Cardamom oil	1 gm	Fragrance
15	Cinnamon powder	2 gm	Aroma
16	Benzoin	2 gm	Fixative
17	Rose water	1 gm	Moistening agent

FORMULATION TABLE 1

Sr. No	Ingredient Name	Quantity	Role
1	Cow dung powder	42 gm	Base, Slow burning
2	Neem powder	14 gm	Strong mosquito Repellent
3	Tulsi powder	3 gm	Repellent, anti- micro
4	Lemongrass powder	2 gm	Natural M. R
5	Jatropha Integerrima extract	4 gm	Active Repellent agent
6	Colophony	10 gm	Binding agent + improves burning
7	Beeswax	5 gm	Binding agent
8	Honey	4 gm	Natural Binder
9	Camphor	6 gm	Quick ignition
10	Eucalyptus oil	3 gm	Strong mosquito Repellent,

11	Clove oil	1 gm	Repellent, anti- micro
12	Lemon oil	1 gm	Repellent
13	Orange oil	1 gm	Fragrance
14	Cardamom oil	1 gm	Fragrance
15	Cinnamon powder	2 gm	Aroma
16	Rose water	1 gm	Moistening agent

METHODOLOGY



1) Preparation of Powder

In the first step, all the herbal raw materials such as cow dung, neem, tulsi, lemongrass, and cinnamon are collected and cleaned properly to remove dirt and unwanted particles. These ingredients are then dried under shade if moisture is present. Shade drying helps preserve the natural active constituents and aroma of the herbs. After complete drying, each ingredient is ground separately into a fine powder using a grinder or mortar pestle. The powdered materials are then passed through a sieve to remove coarse particles and obtain a smooth and uniform powder. This fine powder improves mixing, burning quality, and uniform smoke production in the final dhoop.



Fig 10.1 Preparation Of Powder

2) Mix Dry Ingredients

In this step, all the prepared powders are mixed together to form a uniform herbal base. Cow dung powder, neem powder, tulsi powder, lemongrass powder, cinnamon powder, benzoin, and powdered colophony are taken in a clean and dry bowl. The ingredients are mixed thoroughly using a spatula or by hand until a homogeneous blend is obtained. Proper mixing is important because it ensures equal distribution of all herbal ingredients throughout the dhoop.



Fig 10.2 Mix dry Ingredients

3) Prepare Binder

In this step, beeswax is heated gently on low flame until it melts completely. Overheating is avoided because it may damage the wax and affect the product quality. After melting, honey is added slowly and mixed properly. Honey acts as a natural adhesive and improves texture. A small quantity of rose water is then added to obtain a semi-solid consistency. The prepared binder helps in forming a smooth dough and prevents cracking during drying and storage.

4) Add Active Ingredients

After preparing the herbal base and binder, active mosquito repellent ingredients are added. *Jatropha curcas* extract and powdered camphor are added into the dry mixture and mixed thoroughly. *Jatropha curcas* extract possesses natural insecticidal and mosquito repellent properties, while camphor produces a strong aromatic smoke that helps repel insects.



Fig 10.3 Active Ingredient

5) Add Essential Oils

In this step, different essential oils are added slowly while continuously mixing the formulation. The oils used include eucalyptus oil, clove oil, lemon oil, orange oil, and cardamom oil. These oils provide a pleasant herbal fragrance and also contribute to mosquito repellent activity. Uniform mixing ensures equal distribution of aroma and active volatile compounds throughout the dhoop.



Fig 10.4 Herbal Mixture

6) Dough Formation

The prepared binder from Step 3 is gradually added to the herbal mixture containing powders, active ingredients, and essential oils. The mixture is then kneaded thoroughly to form a soft dough-like mass. Proper kneading helps in achieving uniform consistency and smooth texture. If the mixture becomes too dry, a small amount of rose water is added to improve softness. If the mixture becomes sticky, additional cow dung powder is added to balance the consistency. The final dough should be soft, moldable, and suitable for shaping without cracks.



Fig 10.5 Dough

7) Shaping

Once the dough is prepared, small portions of approximately 10 g are taken and shaped into desired forms such as cones or dhoop sticks. Shaping can be done manually or using molds for uniformity. Proper shaping is important because it affects burning time, smoke release, and appearance of the final product. Uniform size and thickness ensure even burning and better product quality.

8) Drying

The shaped dhoop cones or sticks are placed on clean trays and dried under shade for about 2–3 days. Direct sunlight is avoided because it may evaporate essential oils and reduce fragrance and effectiveness. Shade drying allows slow and uniform removal of moisture, which prevents cracking and maintains product stability. The drying process is continued until the dhoop becomes hard, dry, and completely moisture-free. Proper drying is essential for smooth ignition and uniform burning.



Fig 10.6 Final Product

9) Storage

After drying, the prepared herbal dhoop is stored in airtight containers or moisture-proof packaging materials. The product should be kept away from moisture, humidity, and direct sunlight to preserve its aroma and quality. Proper storage prevents fungal growth, maintains hardness, and increases shelf life. Airtight packaging also helps retain the volatile essential oils and mosquito repellent activity for a longer period.

EVALUATION OF HERBAL DHOOP:

1) Physical Evaluation

In this, the physical properties and their characteristics such as colour, odour are tested.

2) Particle Size Test

The test is designed to check if herbal powders, wood powder, charcoal and binders are milled to the same size. If the particles are not the same size this can affect the mixing, the rolling, the burning rate and the ash formation. Sieve analysis is commonly used to confirm that the powder can pass the required mesh size which results in a smooth and reliable production process.

It guarantees consistent burning, even fragrance distribution, easy blending, and strong bonding when making dhoop sticks or cones. The standard method for this is Analytical Sieving, also known as Sieve Analysis, which adheres to the guidelines set by pharmacopeias. [9]

3) Fragrance Uniformity Test:

It ensures that the perfume or the herbal scent is uniformly distributed in the entire dhoop batch. The smell may not be uniform, in that some pieces may have a stronger smell and others may fade quickly. Samples are drawn from different areas of the batch, tested for scent, and compared to maintain a consistent fragrance in quality and longevity throughout.

To ensure the herbal dhoop aroma is evenly distributed in every batch, we perform a fragrance uniformity test. This process includes randomly picking 10 to 20 dhoop sticks or cones and burning them under the same environmental conditions. [10]

4) Burning Time Test

This test measures how long a dhoop cone burns under normal conditions. Consistent burning time is important for customer satisfaction and product standardization.

The sample is ignited and the total time taken for complete burning is recorded and compared with the product specification. The burning time test for herbal dhoop is conducted to measure the total duration it takes for a dhoop stick or cone to fully burn under controlled conditions. The time taken from the moment it is lit until it is completely burned out is noted using a stopwatch. The uniform burning of all samples shows that the formulation is correct, the moisture level is appropriate, the particles are evenly sized, and the binder is consistent. [11]

F1 = 62 Min

F2 = 74 Min



Fig 11.1 Burning Time Test

5) Smoke Behaviour Test

The smoke behaviour test is a measurement of the amount, colour and smoothness of smoke during burning. A good herbal dhoop should give out a steady and pleasant smoke, without irritation, black smoke or sudden extinguishing. In addition, the test also adds to the assessment of indoor air quality and consumer acceptance in general.



Fig 11.2 Smoke Behavior Test

6) Mosquito Killing Test

The mosquito killing test showed that the prepared herbal dhoop had strong mosquito-killing properties. When exposed to the smoke from the herbal dhoop, the mosquitoes showed quick effects, and full death was observed within 5 seconds under the experimental conditions





Fig 11.3 Mosquito Killing Test

7. Ash Content Test

Ash content testing is used to determine what residue is left after full burning. Excess ash may indicate poor raw material quality, or poor formulation. The rest of the ash is weighed and checked for colour, texture and stability to make sure the burn is clean and controlled.



Fig 11.4 Ash Content Test

Formulation 1:

$$\begin{aligned} \text{Ash Content (\%)} &= (\text{Weight of Ash Residue} / \text{Weight of Original Sample}) * 100 \\ &= 0.50/9.52 * 100 \\ &= 0.0525 * 100 \\ &= 5.25\% \end{aligned}$$

Formulation 2:

$$\begin{aligned} \text{Ash Content (\%)} &= (\text{Weight of Ash Residue} / \text{Weight of Original Sample}) * 100 \\ &= 0.54/9.42 * 100 \end{aligned}$$

$$= 0.0573 * 100$$

$$= 5.73\%$$

RESULT & DISCUSSION

Post Formulation Result

1) Physical Evaluation

i) **Colour:** Dark Greenish Brown

ii) **Odour:** Pleasant

2) Burning Test

Sr. No	Formulation	Burning Time
1	Formulation 1	62 min
2	Formulation 2	74 min

3) Ash value

Sr. No	Formulation	Ash value
1	Formulation 1	5.25%
2	Formulation 2	5.75%

Discussion

In the present study, two formulations of herbal mosquito repellent dhoop, F1 and F2, were prepared using different compositions of herbal ingredients and evaluated by various parameters such as physical evaluation, burning time test, ash content test, mosquito repellent activity, etc. Both formulations showed similar physical properties, effective mosquito repellent activity, and uniform smoke behaviour during evaluation. F1 showed slightly lower burning time and lower ash value, whereas F2 exhibited comparatively longer burning time and slightly higher ash value, with only about 0.50 difference observed between the formulations. Both formulations produced pleasant fragrance and satisfactory performance; however, based on the overall evaluation, F1 was considered better due to its lower ash formation and balanced performance.

CONCLUSION:

The present study reported strong mosquito-killing activity of prepared herbal dhoop which can be used as effective natural mosquito control. In the test of mosquito elimination, smoke of herbal dhoop affected mosquitoes fast and total death was observed within five seconds of exposure under controlled conditions. The efficacy of this formulation is possibly due to the presence of different constituents of medicinal plants that have bioactive substances with insecticidal and repellent properties. Herbal dhoop is a safer, eco-friendly and

non-toxic alternative to synthetic mosquito repellents and chemical fumigants and causes little harm to humans and the environment.

The pleasant herbal smoke and quick action against mosquitoes suggest its potential application in households and public places for protection against mosquito nuisance and mosquito borne diseases such as malaria, dengue and chikungunya. Thus, the developed herbal dhoop can be considered as a promising, economical and sustainable approach for the management of mosquito.

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