

Herbal Mosquito Repellent Dhoop: A Sustainable Alternative to Synthetic Repellents.

Ms. Akshada Karad*, Mr. Aditya Shivankar, Ms. Vanshika Shende, Mr. Darshan Patkar, Mr. Chaitanya Gaikwad, Ms. Kaveri Jigjeni, Prof. Priyanka Panmand.

IVM's, Krishnarao Bhegade Institute of Pharmaceutical Education and Research, Talegaon Dabhade, Pune Maharashtra, 410507.

*Corresponding Author

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ABSTRACT

Diseases spread by mosquitoes are a significant health issue, especially in warm and humid areas around the world. Although synthetic repellents are effective, they can harm the environment and may pose health risks. This study explores the development and evaluation of an herbal mosquito-repellent dhoop (incense) incorporating *Jatropha integerrima* leaf extract along with traditional natural ingredients such as cow dung, clarified butter, and essential oils. The formulation process includes both maceration and ultrasonication extraction techniques, followed by preparation and testing of dhoop sticks in multiple formulations. The herbal dhoop was evaluated through phytochemical screening, physicochemical testing, antimicrobial activity, mosquito repellent efficacy, smoke toxicity, and safety assessments. Results indicated significant antimicrobial effects against *E. coli*, a high mosquito mortality rate, non-irritant smoke, and eco-friendly combustion with low smoke output. The study confirms that *Jatropha*-based herbal dhoop offers a promising, sustainable, and non-toxic alternative to synthetic mosquito repellents.

Keywords: Herbal dhoop, *jatropha integerrima*, mosquito repellent, phytochemicals, incense formulation, antimicrobial activity, natural insecticide, smoke toxicity, eco-friendly repellent, traditional medicine.

INTRODUCTION

Mosquito-transmitted diseases remain a main source of illness and death. Despite decades of malaria control efforts, malaria continues to be a major worldwide public health issue with 3.3 billion persons at risk in 106 countries and territories in the tropical and subtropical areas. (1) Plant-based solutions serve as a safer option to avoid the negative impacts of synthetic chemicals. Herbal products not only purify the air, but they also contribute properties like aroma and positivity to the space in which they are utilized. The current effort primarily focuses on developing the technique of creating *dhoop*, which can be used to reduce the number of microorganisms in the air without the need for chemicals. All of the essential ingredients needed to prepare the *dhoop* are natural. Clarified butter, some herbs, cow manure, and cow milk are among the ingredients. Since ancient times, cow dung has been utilized as a disinfectant. (2)

Hence, to overcome these problems mosquito repellents came into existence. Mosquito repellents are those which help to make surfaces unpleasant to mosquitoes. At present repellents are available in various forms such as the coils, cones and vaporizers. Mainly, the herbal mosquito repellents show more efficiency when compared to other non-herbal repellents due to their non-toxic effects as well they are eco-friendly. (3)

Bio-insecticides composed of botanically or plant derived compounds have been an ideal alternative due to their low level of toxicity to human health and the environment. This review provides current knowledge on the synthetic insecticides currently being used in mosquito control, how they influence the prevalence of

insecticides resistance in mosquitoes, major plant-based insecticides, how they work, and the research on their potential mosquito-compatibility. It also provides an in-depth understanding on how biochemical compounds can be beneficial to synthetic ones as well as how we can overcome insecticide resistance issues in the fight against the transmission of mosquito diseases. (4)

Types of Dhoop: -

The name *Dhoop* came from the name of tree called *Dhoop* which indigenous to eastern India. A chip from these trees imparts pleasant fragrance when they are burnt. *Dhoop* or *Dhoopbatti* is not similar to incense stick or *Agarbatti*. Even from physical appearance they are different. Incense dry and found as a stick but *Dhoop* is a found in paste form with little bit of dampness in it. (5)

1) Charcoal Dhoop: -

To make this type of *dhoopbatti*, an unscented stick is dipped in an oil and perfume combination. In addition, charcoal is added, which will serve as fuel for burning the *dhoop*. Black resins, which give the property of binding, are used to attach the entire mixture to the stick. (6)

2) Masala Dhoop: -

As the name implies, a solid *Dhoopbatti* is prepared by combining a number of aromatic components. Then, it is transformed into a sticky paste by adding water or other adhesives. For the creation of masala *Dhoop*, a variety of natural components are used, including sandalwood, rubber resins, natural oils, root extracts, the leaves and stems of several medicinal plants. (6)

Advantages of Herbal Dhoop (7): -

A. Air purification

1. Enriched with naturally antimicrobial ingredients.
2. Aids in eliminating airborne germs and bacteria.
3. Revitalizes indoor air and minimizes environmental pollutants.

B. Stress relief & mood enhancement

1. Gentle aromas soothe the mind and reduce stress.
2. Promotes mental clarity, inner peace, and emotional stability.
3. Ideal for calming practices such as meditation or reflection.

C. Natural insect repellent

1. Formulated with botanicals known to keep insects at bay.
2. Offers a non-toxic, nature-derived approach to pest control.
3. Safe to use around children, pets, and sensitive individuals.

D. Creates a sacred, peaceful space

1. Instantly transforms surroundings with a tranquil, spiritual feel.
2. Brings a sense of cleanliness and peaceful energy.
3. Commonly incorporated in spiritual rituals and devotional acts.

E. Supports breathing comfort

1. Helps open nasal passages and reduce mild congestion.

2. Provides relief during seasonal sensitivities.
3. Best utilized in spaces with good airflow.

F. Cultural & spiritual significance

1. Strongly connected to ancient traditions and sacred customs.
2. Thought to dispel negative energies and attract good vibes.
3. Frequently used in spiritual healing and energy work.

G. Eco-friendly & safe

1. Composed of earth-friendly and compostable components.
2. Free from artificial chemicals and hazardous emissions.
3. Suitable for consistent, everyday use in all settings.

H. Energy balancing

1. Helps to harmonize the energy within your surroundings.
2. Contributes to both emotional and physical equilibrium.
3. Supports wellness aligned with natural and holistic practices.

I. Promotes restful sleep

1. A gentle solution to support better sleep quality.
2. Helps you unwind and relax before sleeping.
3. A natural option to improve nighttime rest without synthetic aids.

J. Improves focus & creativity

1. Stimulating aromas enhance concentration and innovation.
2. Helps boost mental sharpness and imaginative thinking.
3. Perfect for study sessions, creative tasks, or office environments.

K. Uplifts the mood & environment

1. Fragrances that brighten your spirit and emotional state.
2. Adds a cozy and positive ambiance to your space.
3. Great for social settings or peaceful personal moments

Limitations & disadvantages of dhoop (8): -

A. Smoke irritation

1. Heavy smoke output may lead to discomfort in the eyes, nose, or throat.
2. Can be problematic for individuals with respiratory issues like asthma.

B. Indoor air quality concerns

1. Using it in enclosed or poorly ventilated rooms may degrade indoor air quality.
2. Long-term exposure could trigger allergic reactions or general unease.

C. Fire hazard

1. Leaving burning dhoop unattended carries a fire risk.
2. Always use a designated holder and keep it away from combustible objects.

D. Overpowering fragrance

1. Intense or synthetic aromas may lead to nausea or headaches for sensitive users.
2. Not everyone reacts positively to strong or lingering scents.

E. Residue & staining

1. Ash or oil deposits may collect on nearby surfaces.
2. If used too close, it can leave marks on walls, curtains, or upholstery.

F. Potential allergens

1. Both natural and artificial components might cause allergic responses in certain people.
2. Possible symptoms include coughing, sneezing, or skin irritation.

G. Short-term effects

1. Effects such as mood boost or insect repulsion tend to be brief.
2. Regular use is necessary to maintain the desired impact.

JATROPHA INTEGERRIMA

Jatropha integerrima, commonly known as peregrine or spicy jatropha, is a species of flowering plant in the spurge family, Euphorbiaceae that is native to Cuba and Hispaniola. (9).



Fig No 1:- Jatropha Plant

Table No 1: Taxonomical Classification

Taxonomic Rank	Name
Kingdom	Plantae
Clade	Tracheophytes
Clade	Angiosperms
Clade	Eudicots
Clade	Rosid's
Order	Malpighiales

Family	Euphorbiaceae
Genus	<i>Jatropha</i>
Species	<i>Jatropha integerrima</i>
Binomial Name	<i>Jatropha integerrima</i> Jacq.
Synonyms	<i>Jatropha hastata</i> Jacq.
Uses	Antibacterial, Anti-inflammatory, Antioxidant, Anticancer, Antimicrobial, Antiplasmodial, Anti-tuberculosis, Ornamental uses, Environmental uses.

Phytochemical Constituent:-

Jatropha integerrima also called as Peregrina or Dwarf *Jatropha*. *Jatropha integerrima* contains several chemical compounds in its different parts like, leaves, seeds, flowers, and stems that contribute to its medicinal and toxic properties. Here are some of the major chemical constituents identified in *Jatropha integerrima*. (10)

1. **Alkaloids**
2. **Triterpenoids.**
3. **Flavonoids**
4. **Glycosides**
5. **Fatty Acids and Oils (11)**
6. **Proteins and Lectins**
7. **Saponins**
8. **Cyanogenic Glycosides**
9. **Essential Oils (12)**

Medicinal Uses of Plant:-

Table No 2:- Medicinal Uses

Plant Part	Uses	Details
Leaves	Medicinal	Anti-Inflammatory, Wound Healing, Fever Relief, Skin Conditions (Eczema, Rashes), Insect Repellent.
	Practical	Used As A Poultice For Skin Ailments.(13)
Seeds	Medicinal	Purgative (Small Doses), Antimicrobial.
	Practical	Biofuel Oil Source, Contains Ricin (Highly Toxic) .(14)
Flowers	Medicinal	Treats Fever, Mild Sedative.
	Practical	Ornamental Use In Gardens/Landscaping. (15)
Stem	Medicinal	Analgesic, Anti-Inflammatory.
	Practical	Adds To Ornamental Structure.(16)
Roots	Medicinal	Astringent, Antimicrobial (Used In Small Doses Due To Toxicity).(17)

The Fatty Acid & Volatile Oils Present In *Jatropha Integerrima* Plant: -

The essential oils and fatty acids in *Jatropha integerrima* enhance its therapeutic properties and biological effects. These compounds are responsible for the plant's insect-repellent properties."

Fatty Acids: -

1. **Linoleic acid (C18:2):** Omega-6; anti-inflammatory, supports heart health.
2. **Oleic acid (C18:1):** Omega-9; heart-healthy, anti-inflammatory.

3. **Palmitic acid (C16:0):** Saturated; common in plant oils, may raise cholesterol in excess.
4. **Stearic acid (C18:0):** Saturated; mild antimicrobial, found in plant/animal fats.
5. **Linolenic acid (C18:3):** Omega-3; usually in small amounts.(18)

Volatile Oils: -

1. **Cineole (Eucalyptol):** Anti-inflammatory, analgesic, antimicrobial; helps with respiratory issues.
2. **Terpene Hydrocarbons:** Includes limonene (citrusy, antimicrobial) and α -pinene (anti-inflammatory, bronchodilator).
3. **Camphor:** Aromatic; used for its anti-inflammatory, analgesic, and antiseptic effects.
4. **α - and β -Caryophyllene:** Sesquiterpenes with anti-inflammatory, analgesic, and antimicrobial actions.
5. **Linalool:** Found in lavender; calming, anti-anxiety, and anti-inflammatory.
6. **Fatty Acids:** Includes linoleic, oleic, palmitic, stearic, and linolenic acids.
7. **Volatile Oils Summary:** Contains cineole, camphor, terpenes (limonene, α -pinene), caryophyllene, and linalool.(19)

MATERIALS AND METHOD OF EXTRACTION

Materials Used In Preparation Of Herbal Dhoop:-

Camphor, Coconut Oil, Bees Wax, Saw Dust Powder, Starch, Benzoin, Lemon Oil, Acacia, Rose Water, Tragacanth, Cow Dung, Raal Resin, Kapur Kachari, Cow Ghee, Loban, Water, Jatropha Plant Extract. (20)

Preparation Of Aqueous Extract Of *Jatropha Integerrima* (Leaves):-

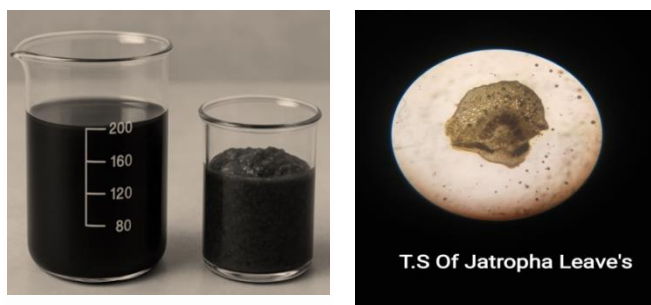


Fig No 2:-Extraction and T.S of Jatropha Plant

1. Maceration Method (Conventional Extraction) (21):-

1. **Collection:** Harvest healthy, fresh Jatropha leaves.
2. **Cleaning:** Wash thoroughly to remove dirt and impurities.
3. **Drying:** Shade-dry at room temperature until crisp.
4. **Grinding:** Crush dried leaves into coarse powder.
5. **Soaking:** Mix powder with solvent (ethanol, methanol, or water) in 1:5 or 1:10 ratio.
6. **Maceration:** Let sit for 24–72 hours at room temperature with occasional stirring.
7. **Filtration:** Filter through Whatman paper to separate extract.
8. **Concentration:** Evaporate solvent gently to concentrate extract.

2. Ultrasonication Method (22):-

1. **Collection:** Select fresh, healthy Jatropha leaves.
2. **Washing:** Rinse thoroughly with clean water.
3. **Drying:** Shade-dry until fully moisture-free.
4. **Grinding:** Coarsely grind the dried leaves.

5. **Weighing:** Measure leaf powder as per desired ratio.
6. **Solvent Mixing:** Add solvent (ethanol/methanol/water) in 1:10 (w/v) ratio.
7. **Ultrasonication:** Sonicate at 20–40 kHz for 15–60 mins at $\leq 50^{\circ}\text{C}$.
8. **Filtration:** Filter to remove solid residues.
9. **Concentration:** Concentrate extract via rotary evaporation or gentle heating.

METHODS OF PREPARATION (23,24)

Table No 3:- Formulation of Incense

Ingredients	F1 <i>Acacia</i>	F2 <i>Benzoin</i>	F3 <i>Tragacanth</i>	F4 <i>Cow</i> <i>Dung</i>	Function / Uses.
Acacia	5.0 gm	–	–	–	Binder Used In F1.
Benzoin	–	5.0 gm	–	–	Binder (F2), Aromatic Fixative.
Tragacanth	–	–	5.0 gm	–	Binder Used In F3.
Cow Dung	–	–	–	20gm	Binder And Base In F4, Natural Fuel.
Coconut Oil	2.0 gm	2.0 gm	2.0 gm	2.0 gm	Softens Dough, Improves Binding, & Texture.
Beeswax	3.0 gm	3.0 gm	3.0 gm	3.0 gm	Soft Binder Improves Texture & Burning.
Starch	2.0 gm	2.0 gm	2.0 gm	2.0 gm	Binder & Structure Stabilizer.
Lemon Oil	1.0 ml	1.0 ml	1.0 ml	1.0 ml	Mosquito Repellent, Refreshing Scent.
Rose Water	2.0 ml	2.0 ml	2.0 ml	2.0 ml	Fragrance And Helps In Mixing.
Cow Ghee	5.0 gm	5.0 gm	5.0 gm	5.0 gm	Fragrance Enhancer Improves Burn.
Saw Dust Powder	40.0 gm	40.0 gm	40.0 gm	40.0 gm	Base, Aids Combustion & Shape.
Raal (Resin)	3.0 gm	3.0 gm	3.0 gm	3.0 gm	Adds Texture, Resinous Fragrance.
Kapur -Kacheri	2.0 gm	2.0 gm	2.0 gm	2.0 gm	Aromatic, Antibacterial, Insect Repellent.
Loban	3.0 gm	3.0 gm	3.0 gm	3.0 gm	Fragrance, Spiritual Uses, Calming Smoke.
Jatropha Plant Extract (API)	2.0 gm	2.0 gm	2.0 gm	2.0 gm	Mosquito Repellent, Antimicrobial.
Water	10 ml	10 ml	10 ml	10ml	For Dough Preparation.

Procedure (25, 26):-

Step 1: Weighing and Preparing Materials

1. Accurately weigh all ingredients.
2. Sieve powdered materials like Acacia, starch, saw dust, raal, Kapur kacheri, and Loban to remove lumps.
3. Keep all liquids in clean separate containers.

Step 2: Preparation of Binders

1. Add All Binding Agents in this.

Step 3: Mixing Saw Dust Base

1. Add saw dust powder to the Acacia mucilage.
2. Mix thoroughly for even distribution and initial binding.

Step 4: Incorporating Softening and Binding Agents

1. Melt beeswax gently (using a water bath if necessary).

2. Add melted beeswax, coconut oil, starch, and cow ghee into the saw dust mixture.
3. Mix well to form a cohesive blend.

Step 5: Adding Fragrance and Functional Ingredients

1. Add lemon oil and rose water.
2. Incorporate raal, Kapur kacheri, Loban, and jatropa plant extract.
3. Mix thoroughly too evenly distribute aroma and functional properties.

Step 6: Final Dough Preparation

1. Gradually add water as needed while kneading the mixture.
2. Knead for 10–15 minutes until smooth, pliable dough is formed.

Step 7: Shaping

1. Shape the dough into dhoop incense of desired size.
2. Smooth the surface to ensure uniform appearance.

Step 8: Drying

1. Dry the shaped dhoop sticks in shade for 48–72 hours, or
2. Use a tray dryer at 40–45°C for 6–8 hours until completely dry and firm.

EVALUATION

Physiochemical Evaluation Test Of Jatropa Extract:-

1. Detection of Alkaloids (27):-

1. Hager's test

Procedure:

1. Take 2 ml of the plant extract in a clean test tube.
2. Add a few drops of Hager's reagent.
3. Shake the test tube gently.
4. Observe the formation of a yellow precipitate.

2. Mayer's test

Procedure:

1. Take 2 ml of the plant extract in a test tube.
2. Add a few drops of Mayer's reagent.
3. Shake gently and allow to stand.
4. Observe the formation of a white or cream-colored precipitate.

3. Wagner's test

Procedure:

1. Take 2 ml of plant extract in a clean test tube.
2. Add a few drops of Wagner's reagent.
3. Shake gently and observe for any precipitate formation.

2. Detection of Glycosides (28):-

1. Baljet's test (*for cardiac glycosides*)

Procedure:

1. Take 2 ml of the plant extract in a test tube.
2. Add 2 ml of baljet's reagent (freshly prepared sodium picrate).
3. Mix the solution well.
4. Allow it to stand for a few minutes.
5. Observe for orange or red coloration.

2. Liebermann's test (*for cardiac glycosides*)

Procedure:

1. Take 2 ml of the extract in a dry test tube.
2. Add 1 ml of acetic anhydride.
3. Carefully add 2–3 drops of concentrated H_2SO_4 along the side of the test tube.
4. Observe the color change at the junction.

3. Foam test (*for saponin glycosides*)

Procedure:

1. Take 2 ml of the plant extract in a test tube.
2. Add 5 ml of distilled water.
3. Shake the mixture vigorously for 2–3 minutes.
4. Let it stand for 10–15 minutes.
5. Observe for the formation and stability of foam.

3. Detection of Fatty Acids and Volatile Oils (29):-

1) Solubility in Benzene

Procedure:

1. Take 2 ml of the extract in a test tube.
2. Add 2 ml of benzene.
3. Shake the test tube gently.
4. Observe whether the extract dissolves completely or separates.

2) Solubility in Chloroform

Procedure:

1. Take 2 ml of the extract in a test tube.
2. Add 2 ml of chloroform.
3. Shake gently.
4. Check for solubility or layer separation.

3) Solubility in Ethanol

Procedure:

1. Take 2 ml of the extract in a test tube.
2. Add 2 ml of ethanol.

3. Shake well.
4. Observe if the solution is clear or if a layer is formed.

4) Solubility in Water

Procedure:

1. Take 2 ml of the extract in a test tube.
2. Add 2 ml of distilled water.
3. Shake vigorously.
4. Observe whether the extract dissolves or forms a separate layer.

4. Detection Of Steroids (30) :-

1. Salkowski's test

Procedure:

1. Take 2 ml of extract in a clean dry test tube.
2. Add 2 ml of chloroform.
3. Carefully add 2 ml of concentrated sulfuric acid from the side of the test tube to form a separate lower layer.
4. Observe the interface between the two layers.

2. Liebermann–burchard's test

Procedure:

1. Take 2 ml of the extract in a dry test tube.
2. Add 2 ml of acetic anhydride.
3. Add 2–3 drops of concentrated sulfuric acid carefully from the side of the test tube.
4. Mix gently and observe for a gradual color change.

3. Liebermann's test

Procedure:

1. Take 2 ml of extract in a test tube.
2. Add 2 ml of acetic anhydride.
3. Slowly add 2–3 drops of Sulfuric acid.
4. Observe the solution for any blue color

EVALUATION OF DHOOP

Physical Parameter Evaluation

The physical characteristics of the wide, small-sized cylindrical dhoop sticks were evaluated for uniformity and aesthetic appeal. Ten sticks were randomly selected and measured using a vernier caliper. The average length was found to be 2.9cm, indicating a compact form factor. The average width was 1.1 cm, confirming their relatively wide cylindrical shape. Visual inspection revealed a uniform brown colour and aromatic like smell, a hard and well-compacted surface texture, and no visible cracks or structural deformities. The sticks maintained a consistent shape and quality, confirming good manufacturing integrity and physical stability.

(31)

Flammability And Burning Time

The flammability and the burning time of the dhoop was checked by burning the Dhoop. It was observed that the dhoop was burnt completely creating low smoke and The burning time was 35 minutes. (31)

Moisture Content

The prepared dhoop's initial weight was lighted, and the dried dhoop's ultimate weight Was recorded. The moisture content was found to be 4.5% .

Moisture content

- **Initial weight (w_1)** = 5.00 gm (*before drying*).
- **Dry weight (w_2)** = 4.775 gm (*after drying*).

$$\text{Moisture Content (\%)} = \frac{\text{Initial Weight} - \text{Dry Weight}}{\text{Initial Weight}} \times 100$$

This formula was we used to detect moisture content. (31)

Ash Value

The dhoop stick was burnt completely and the ash was collected and weighed. The weight of ash 2.04 gm. (31)

$$\text{Ash Value (\%)} = \frac{\text{Weight of Ash}}{\text{Initial Sample Weight}} \times 100$$

This formula was we used to detect ash value.

Microbiological Evaluation

Microbiological evaluation was carried out to assess the efficacy of the formulation With respect to its antagonistic effect against respiratory pathogens. Firstly, nutrient agar powder was dissolved in water & kept in autoclave for 30-45min. Then transferred to Petri plates & allow it to settle for 20 min. A sterile corn borer was used to make wells of equidistance in each plate. At last, the E. coli culture was spread evenly and kept in incubator for 24 hours at 37 degrees Celsius. (32)

Irritability

The dhoop was burnt and its irritancy was checked whether it's irritating to our nose or Leads to coughing or sneezing. (32)

Smoke Toxicity Test

Smoke toxicity experiment was conducted in a chamber. The mosquitoes were attracted by Using a pair of socks and the mosquitoes were exposed to the smoke of burning incense For 45 min. And the mortality data was recorded after every 20 min. (32)

Mosquito Repellant Activity

The dhoop was burnt in the mosquito prone areas in the evening and night period. For Investigating mosquito repellent activity, the prepared incense sticks are checked for Causal effect such as irritation,

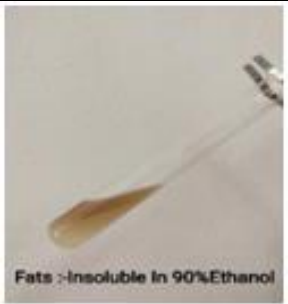
coughing, and tears was observed and recorded. the repellency activity by the stick or dhoop to the when burning in a corner of home having Mosquitoes and it explain that natural insecticidal preparation are always effective than Synthetic. (32)

RESULT AND DISCUSSION

1) Physicochemical Test Results:-

Table No 4:-Chemical Test

SR. NO	CHEMICAL	TEST NAME	OBSERVATION	RESULT
1	Alkaloids	Mayur's Test		Precipitate Not Found Alkaloids Absent
		Hager's Test		Yellow Precipitate Found Alkaloids Present
		Wagner's Test		Reddish Brown Precipitate Found Alkaloids Present
2	Glycosides	Baljet's Test		Orange Color Not Found Cardiac Glycosides Absent
		Liebermann's Test		Blue Color Not Found Cardiac Glycosides Absent

		Foam Test		Foam Occurred Saponin Glycosides Present
3	Fatty Acids & Volatile Oils	In Benzene		Soluble Fatty Acids Present
		In Chloroform		Soluble Fatty Acids Present
		In Ethanol		Soluble; Layer Formed Fatty Acids Present
		In Water		Insoluble Fatty Acids Absent
4	Steroids	Salkowski Reaction		Greenish Yellow Fluorescence Not Observed Steroids Absent

		Liebermann's-Burchard Reaction		Green Color Not Found Steroids Absent
		Liebermann's Reaction		Blue Color Not Found Steroids Absent

2) Evaluation Test Results :-

Physical Parameter For Dhoop(31):-

Table No 5:-Physical Parameter

Length	2.9 cm.
Width	1.1 cm.
Weight	3.2 gm.
Color	Uniform brown.
Odour	Aromatic smell.
Texture	Hard and well-compacted.
Shape	Wide, cylindrical, no cracks.

Flammability And Burning Time Of Dhoop (31) :-

Table No 6:-Flammability and Burning Time

Parameter	Observation	Inference
Flammability	Burns completely	Good flammability.
Smoke Production	Low smoke	Eco-friendly and safe for inhalation.
Burning Time	35 minutes	Satisfactory and long-lasting.



Fig No 3:-Burning Dhoop

Moisture Content Of Dhoop (31):-

Table No 7:- Moisture Content

Parameter	Value	Remarks
Initial Weight (W_1)	5.00 gm	Before drying.
Final Weight (W_2)	4.775 gm	After complete drying.
Moisture Content (%)	4.5%	Indicates good drying; stable for storage.

Ash Value Of Dhoop (31):-

Table No 8:-Ash Value

Parameter	Value	Remarks
Initial Weight (W_1)	5.00 g	Weight before burning.
Weight of Ash (W_2)	2.04 g	Residue left after complete burning.
Ash Value (%)	40.8%	Indicates total inorganic content.

Microbiological Evaluation Against *Coli* (32) :-

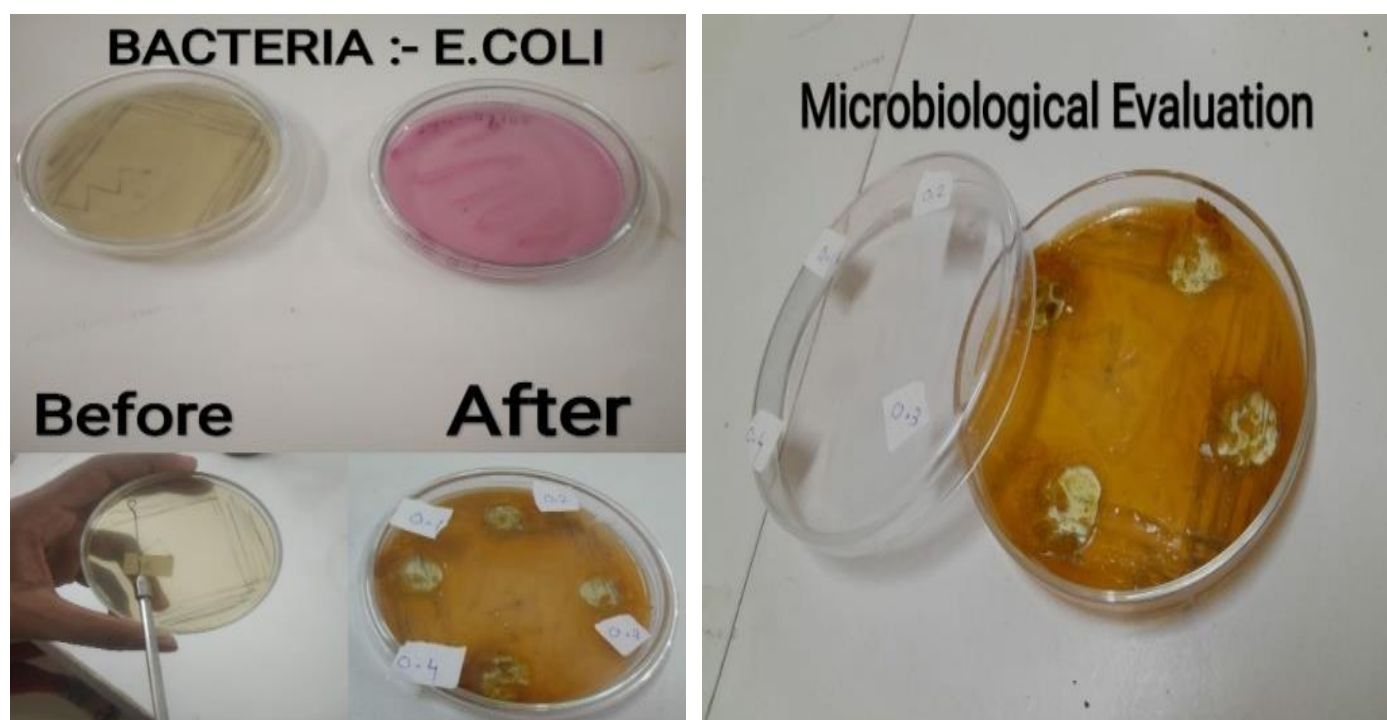


Fig No 4: Microbial Plate (E.Coli Bacteria)

Table No 9:- Microbiological Evaluation

Sample	Zone of Inhibition (mm)	Observation	Inference
Standard (Ofloxacin)	24 mm	Clear, well-defined zone around the well	Positive control; effective antibiotic.
Test Sample (Dhoop extract)	15 mm	Moderate clear zone around the well	Shows antimicrobial activity.
Control (Blank well, if any)	0 mm	No zone	No antimicrobial effect.

Irritability Evaluation Of Dhoop Smoke (32):-

Table No 10:-Irritability Evaluation

Parameter Evaluated	Observation	Inference
Nasal Irritation	No irritation observed	Dhoop smoke is non-irritant to the nasal tract.
Coughing	No coughing observed	Indicates smooth and tolerable smoke.
Sneezing	No sneezing observed	Safe for inhalation.
Eye Irritation (if observed)	No eye irritation noticed	Gentle smoke, suitable for indoor use.

Smoke Toxicity Test (Mosquito Mortality) (32):-

Table No 11:- Smoke Toxicity Test

Time Interval (min)	Number of Mosquitoes Exposed	Number of Dead Mosquitoes	Mortality Rate (%)
0 min (Before Exposure)	20	0	0%
After 20 min	20	6	30%
After 40 min	20	13	65%
After 45 min	20	17	85%

Mosquito Repellent Activity Of Dhoop (32) :-



Fig No 5:- Mosquito Repellent Activity (Before and After)

Table No 12:-Mosquito Repellent Activity

Observation Parameter	Observation	Inference
Presence of Mosquitoes	Significantly reduced	Indicates strong repellent activity
Smoke-induced Irritation	No irritation observed	Safe for human use
Coughing/Sneezing	None	Non-irritant smoke
Tears/Eye Irritation	None	Comfortable during burning
Repellency Effectiveness	High	Natural formulation effectively repels mosquitoes

CONCLUSION

In this study, an herbal dhoop was formulated using cow-derived products and medicinal herbs. Its effectiveness against airborne microbes can be accessed through antimicrobial evaluation. The findings of this research revealed significant antimicrobial activity of the dhoopbatti against airborne pathogens. This herbal dhoopbatti is made from readily accessible and economically viable raw materials. In India, such dhoopbattis are traditionally used during rituals like homa or havan. Compared to expensive synthetic alternatives, dhoopbatti offers a cost-effective and natural solution. This work highlights that with a systematic and focused manufacturing approach using natural components, herbal dhoopbatti has strong future potential as an eco-friendly product.

REFERENCE

1. Asadollahi, A., Khoobdel, M., Zahraei-Ramazani, A., Azarmi, S., Mosawi, S.H., "Effectiveness of Plant-Based Repellents Against Different *Anopheles* Species: A Systematic Review," *Smilar Journal*, 18, 2019, pp. 436.
2. Guru, S.E., Padole, N., Baheti, J., "Formulation and Evaluation of Herbal Dhoop from Temple Waste for Mosquito Repellent Activity," *International Journal of Pharmaceutical Science and Research*, 2(7), 2024, Article ID: IJPS/240207017.
3. Patel, K., Sharma, N., Mehta, R., "Formulation and Evaluation of Herbal Mosquito Repellent in Two Dosage Forms Used in Folklore Practice," *International Journal of Pharmaceutical Science and Research*, 11(5), 2020, pp. 2456–2461.
4. Sharma, V., Sharma, A., Joshi, S., Ojha, P., Soni, S., Saxena, A., Vyas, S., "Human Health Risks to the Use of Chemical Mosquito Repellents: A Review," *International Journal of Mosquito Research*, 11(1), 2024, pp. 161–167.
5. Gupta, M., *The Cultural Significance of Dhoop and Agarbatti in Indian Ritual*, Indian Culture Heritage Foundation, Delhi, 2020.
6. Guru, S., Padole, N., Baheti, J., "Formulation and Evaluation of Herbal Dhoop from Temple Waste for Mosquito Repellent Activity," *International Journal of Pharmaceutical Sciences*, 2024, Published: 21 July.
7. Sahu, B., Dutta, S., Mishap, S.P., Chute, S., Kumar, L., Soni, A.G., Deranging, K., "A Brief Review on Dhoop and Its Properties," *Journal of Preventive Medicine and Holistic Health*, 2021.
8. Ranasinghe, M.S., Arambewela, L., Samarasinghe, S., "Development of Herbal Mosquito Repellent Formulations," *International Journal of Pharmaceutical Sciences and Research*, 7(9), 2016, pp. 3643–3648.
9. Schmelzer, G.H., Gurib-Fakim, A., *Plant Resources of Tropical Africa: Medicinal Plants 1*, PROTA Foundation, Wageningen, 2008, pp. 305–307.
10. Morton, J.F., "Jatropha Integerrima and Related Species as Ornamental Plants," *Proceedings of the Florida State Horticultural Society*, 89, 1976, pp. 230–233.
11. Duke, J.A., *Handbook of Medicinal Herbs*, 2nd ed., CRC Press, Boca Raton, 2002, pp. 356–358.
12. Orwa, C., Mutua, A., Kindt, R., Jamnadass, R., Simons, A., *Agroforestry Database: A Tree Reference and Selection Guide*, Version 4, World Agroforestry Centre, Nairobi, 2009.
13. Devappa, R.K., Makkar, H.P.S., Becker, K., "Jatropha Toxicity: A Review of the Toxicological Mechanisms of the Toxins Found in Jatropha Curcas Seed," *Journal of Toxicology and Environmental Health, Part B: Critical Reviews*, 13(6), 2010, pp. 476–507.
14. Edeoga, H.O., Okwu, D.E., Mbaebie, B.O., "Phytochemical Constituents of Some Nigerian Medicinal Plants," *African Journal of Biotechnology*, 4(7), 2005, pp. 685–688.
15. Openshaw, K., "A Review of Jatropha Curcas: An Oil Plant of Unfulfilled Promise," *Biomass and Bioenergy*, 19(1), 2000, pp. 1–15.
16. Achten, W.M.J., Verchot, L., Franken, Y.J., Mathijs, E., Singh, V.P., Aerts, R., et al., "Jatropha Bio-Diesel Production and Use," *Biomass and Bioenergy*, 32(12), 2008, pp. 1063–1084.

17. Makkar, H.P.S., Becker, K., Sporer, F., Wink, M., "Studies on Nutritive Potential and Toxic Constituents of Different Provenances of *Jatropha Curcas*," *Journal of Agricultural and Food Chemistry*, 45(8), 1997, pp. 3152–3157.
18. Becker, K., Makkar, H.P.S., "Jatropha: A Potential Source for Tomorrow's Oil and Biodiesel," *Liebigs Annalen der Chemie*, 7, 2005, pp. 56–59.
19. Heller, J., *Physic Nut: Promoting the Conservation and Use of Underutilized and Neglected Crops*, International Plant Genetic Resources Institute, Rome, 1996.
20. Randhawa, G., Kullar, J., "Bioremediation of Pharmaceuticals, Pesticides, and Petrochemicals with Gomeya (Cow Dung)," *ISRN Pharmacology*, 2011, Article ID 362459, pp. 1–7.
21. Azwanida, N.N., "A Review on the Extraction Methods Use in Medicinal Plants, Principle, Strength, and Limitation," *Medicinal and Aromatic Plants*, 4(3), 2015, pp. 196.
22. Chemat, F., Rombaut, N., Sicaire, A.G., Meullemiestre, A., Fabiano-Tixier, A.S., Abert-Vian, M., "Ultrasound-Assisted Extraction of Food and Natural Products: A Review," *Ultrasonics Sonochemistry*, 34, 2017, pp. 540–560.
23. Neelamma, G., Ramesh, A., More, K., Shanthi, N., Gunturu, N., "Design and Evaluation of Polyherbal Mosquito Repellent Incense Sticks," *Research Journal of Pharmacognosy and Phytochemistry*, 16(1), 2024, pp. 23–25.
24. Kumar, P., Singh, M., "Study of Different Composition for Preparation of Incense Stick Using Temple Waste," *The Pharma Innovation Journal*, 12(9), 2023, pp. 696–700.
25. Yadav, I., Juneja, S., Chauhan, S., "Temple Waste Utilisation and Management: A Review," *International Journal of Engineering Technology Science and Research*, 2, 2015, pp. 2394–3386.
26. Adhikary, K., Vishwavidyalaya, M., "Management of Temple Floral Waste and Utilization of Value-Added Floral Waste Product: A Review," *International Journal for Environmental Rehabilitation and Conservation*, 11, 2020, pp. 120–128.
27. Lin, T.C., Krishnaswamy, G., Chi, D.S., "Incense Smoke: Clinical, Structural and Molecular Effects on Airway Disease," *Clinical and Molecular Allergy*, 6, 2008, pp. 3.
28. Yang, T.T., Chen, M.L., "Effects of Incense Smoke on Indoor Air Quality and Health of Adult Residents in Taiwan," *Journal of Hazardous Materials*, 398, 2020, Article ID 122867.
29. Lung, S.C., Hu, S.C., "Generation Rates and Emission Factors of Particulate Matter and Particle-Bound Polycyclic Aromatic Hydrocarbons of Incense Sticks," *Chemosphere*, 50(5), 2003, pp. 673–679.
30. Wang, B., Lee, S.C., Ho, K.F., Kang, Y.M., "Characteristics of Emissions of Air Pollutants from Burning of Incense in a Large Environmental Chamber," *Atmospheric Environment*, 41(37), 2007, pp. 7851–7858.
31. Chen, Y.C., Ho, W.C., Yu, Y.H., "Adverse Health Effects of Household Incense Burning: A Review," *International Journal of Environmental Research and Public Health*, 14(10), 2017, Article ID 1107.
32. See, S.W., Balasubramanian, R., "Physical Characteristics of Particulate Matter Emitted from Burning Incense Sticks and Candles," *Atmospheric Environment*, 42(39), 2008, pp. 8840–8849.
33. Koo, L.C., Ho, J.H., "Diet as a Confounder in a Study of Lung Cancer and Incense Smoke Exposure in Hong Kong," *Preventive Medicine*, 25(5), 1996, pp. 611–616.
34. Yang, C.Y., Chiu, H.F., Cheng, M.F., Lin, M.C., "Effects of Incense Burning on Indoor PM_{2.5} and CO Concentrations in Taiwanese Temples," *Building and Environment*, 42(10), 2007, pp. 3729–3735.