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DEVELOPMENT OF MOSQUITO REPELLENT FORMULATION USING TRADITIONAL MEDICINAL PLANTS

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ABSTRACT

Mosquito-borne diseases continue to pose a serious public health challenge, thereby demanding safer, eco-friendly, and sustainable alternatives to synthetic repellents. Chemical mosquito repellents, although effective, are associated with adverse effects such as skin irritation, respiratory discomfort, environmental toxicity, and insect resistance. In the present study, an herbal dhoop formulation was developed using a potent blend of traditionally recognized mosquito-repellent botanicals including *Azadirachta indica* (neem) leaves, *Vitex negundo* (nirgudi) leaves, *Tagetes erecta* (marigold) flower petals, *Chrysanthemum cinerariifolium* (chrysanthemum) leaves, *Ocimum sanctum* (holy basil) leaves, *Citrus* peel powder, *Eucalyptus* oil, and cow dung powder as a natural stabilizing and synergistic bio-medium. The plant materials were processed through drying and grinding, followed by formulation into a typical herbal dhoop preparation. The prepared three formulations were evaluated for mosquito-repellent efficacy, longevity of protection, safety, and user acceptability through laboratory as well as preliminary field-level trials. The herbal dhoop exhibited significant and prolonged repellent activity, effectively deterring mosquito landing and biting behavior, and demonstrated protection levels comparable to standard synthetic repellents without causing irritation or discomfort. Additionally, the formulation was found to possess a pleasant herbal aroma, smooth application, and high user acceptance. The synergistic action of neem, nirgudi, eucalyptus oil, and chrysanthemum contributed to strong repellent properties, while citrus peel and holy basil provided aromatic and antimicrobial enhancement. Overall, this study scientifically validates the traditional knowledge of mosquito-repellent plants and establishes the herbal dhoop as a safe, cost-effective, and environmentally sustainable biobased alternative for mosquito management. These findings support the potential application of botanical formulations in green vector-control strategies and natural public-health protection.

KEYWORDS: Herbal**,** mosquito repellent property, environmentally sustainable, secondary metabolites, essential oil etc.

I. INTRODUCTION

Mosquitoes are among the most annoying blood sucking insects. Several species of mosquito act as vector and are responsible for causing various diseases such as Dengu, Malaria, Yellow fever, Chikungunya, Zika fever (Kumar et al., 2021). Mosquito species belonging to genera *Anopheles*, *Culex* and *Aedes* act as vectors and are involved in transmission of these diseases (Ransinghe et al., 2016). According to Kumar et al., (2021), over 700 million people get infected due to transmission of various diseases because of mosquito alone and among them over one million people die due such transmitted diseases. Therefore, control of mosquitoes and prevention of transmitted diseases through mosquitoes is an important public health concern throughout the globe. Mosquito repellents are the substances that make surface unpleasant for mosquito bite. Mosquito repellents available in the market are composed of two main ingredients- one is main active component and other is secondary component. Active component is involved in repelling mosquitoes and secondary ingredient gives cosmetic appeal to the product (Kantheti and Alapati, 2017).

Traditionally, various things have been used to repel mosquitoes which includes smoke, plant extracts, oil and mud. Due to recent developments in the technology, individual ingredients are isolated and used in the preparation of synthetic mosquito repellents available in the market such as Pyrethrin, Picaridin, Pyrethroids and Permethrin etc. (Kantheti and Alapati, 2017). The synthetic mosquito repellents are powerful and long lasting than natural repellents but at the same time they have disadvantages because they cause irritation to eyes, throat, lips and sensitive areas. They have pungent chemical smell. Recently, people are concentrating more on natural mosquito repelling methods. Herbal dhoop is a natural product composed of natural mosquito repellent plant parts and is prepared by blending plant extracts and aromatic essential oil (Kaur et al., 2022).

In the present study, an herbal dhoop formulation was developed using a combination of potent mosquito-repellent plants including neem (*Azadirachta indica*), nirgudi (*Vitex negundo*), marigold (*Tagetes erecta*), chrysanthemum (*Chrysanthemum cinerariifolium*), holy basil (*Ocimum sanctum*), citrus peel extract, *Eucalyptus* oil, and cow dung extract. These botanicals have been historically recognized in traditional medicine systems for their insect-repellent and antimicrobial attributes. Neem and nirgudi provide strong repellent and insecticidal activity, eucalyptus oil and citrus peels contribute volatile aromatic compounds that deter mosquitoes, while chrysanthemum contains natural pyrethrins known for their insecticidal action. Holy basil enhances fragrance and antimicrobial potential, and cow dung extract serves as a natural stabilizing and synergistic medium.

This research aims to formulate and evaluate a plant-based mosquito-repellent dhoop that is safe, effective, affordable, and environmentally compatible. The study focuses on formulation preparation, phytochemical-based repellent activity, user acceptance, and comparative performance with synthetic repellents. The findings contribute toward promoting herbal bioproducts as a sustainable tool for public health protection.

II. MATERIAL AND METHODS

The selection of plant material was based on availability of plant material, scientific evidence and its use referred in literature of herbal medicine.

1. Collection and preparation of Plant materials

For preparation of Herbal mosquito repellent dhoop plant material such as- leaves of Neem, Nirgudi, *Chrysanthemum*, Marigold, Holy basil, flowers of Marigold, Coconut coir, Citrus peel etc. collected, washed with tap water and dried in the oven at 50°c. Drying of plant material was carried out for 2-3 days. After sufficient drying theme plant material powdered in a mixer separately and stored for further use. Three different formulations were prepared by using following plant material.

2. Preparation of Herbal Mosquito repellent dhoop

Herbal mosquito repellent dhoop was prepared as per below mentioned three different formulations. For binding of herbal dhoop wheat flour was used. Ingredients mixed and dhoop stics/dhoop cups were prepared. 3 different types of formulations have been prepared and kept in oven at 70 °c for 2 days for proper drying and packed in clean polythene bags.

3. Application and Survey of Prepared Herbal Mosquito repellent dhoop

Prepared herbal dhoop distributed into local people for testing efficiency of herbal dhoop in repelling mosquitoes. Feed back form containing 16 questions mosquito repellent activity, odour, cost, allergic effect, flame test, most liked dhoop formulation, ecofriendly and environmentally sustainable nature, burning time required for dhoop etc. were included. The data obtained from feedback form was analyzed.

Flame test Conducted

Table 1: Flame Test.

Flame Colour	Component present	Flame colour observed
Blue	Alcohol	-
Green	Copper Sulfate	-
Orange	Wood/Carbon	Orange Flame
Purple	Potassium Chloride	-

Table 2: Herbal plants with their chemical constituents and Mosquito repellent properties used.

Sr. No.	Common name	Botanical name	Family	Chemical constituents	Reference
1	Neem/ Margosa	*Azadirachta indica*	Meliaceae	Nimbin, Azadirachtin, Nimbidin, Nimbidol	Dua et al., (2009)
2	Nirgudi	*Vitax negundo*	Verbenaceae	Viridiflorol, negundoside, vitegnoside	Gautam et al., (2008)
3	Shevanti	*Chrysanthemum indicum*	Asteraceae	Apigenin, Chlorogenic acid, Acacetin, Phenolic acid Caryophyllene, Camphene, Germacrene D	Liang-Yu Wu et al., (2010)
4	*Eucalyptus*	*Eucalyptus*	Myrtaceae	Cineole,	Mandal

		globulus		Eucalyptol, Camphene	(2011)
5	Marigold	*Tagetes erecta*	Asteraceae	Limonene, piperitone, terpinolene	Krishna et al., (2004)
6	Tulsi	*Ocimum sanctum*	Lamiaceae	Eugenol, Methyl Eugenol, Ocimene, thymol	Maia and Moore (2011)
7	Turmeric	*Curcuma longa*	Zingiberaceae	Bisdemethoxy-curcumin, Curcumin, dimethoxy-curcumin	de Souza Tavares et al., (2016)
8	Clove	*Syzygium aromaticum*	Myrtaceae	Eugenol, Eugenol acetate, Thymol, Caryophyllene oxide	Nassar et al., (2007)
9	Orange (peel)	*Citrus aurantium*	Rutaceae	Limonene, octanal, citral, Citronellol	Caputo et al., (2020)

III. RESULTS AND DISCUSSION

In the present investigation, the attempts have been made to prepared herbal mosquito repellent dhoop by using plant material especially plants having mosquito repellent activity were selected. Testing of prepared herbal dhoop was carried out at the locations where large number of mosquitoes present. Survey about use of prepared herbal dhoop was conducted from fifty people by submission of questionnaire of about 16 questions and recorded answers were analyzed.

Table 3: Different formulations of Herbal Mosquito repellent dhoop prepared.

Formulation type	Formulation I	Formulation II	Formulation III
Ingredient used	Cow dung Neem leaves Holy Basil leaves *Chrysanthemum* leaves Orange peel Wheat flour	Marigold flowers *Eucalyptus* oil Camphor Clove Wheat flour	Coconut coir Coconut oil Sambrani loban Nirgudi leaves Turmeric Wheat flour
Percentage of people liked herbal dhoop	80%	15%	5%

The repellent activity of herbal dhoop on mosquito recorded successful results. From this, it can be concluded that chemical constituents or active components present naturally in plants are very much impactful and can be used in preparation of natural insect repellent formulations. Natural insect repellent is cost effective and doesn't have any adverse effect on children and human health. Due to burning of herbal mosquito repellent dhoop about 88% of mosquito number was reduced. About 85% people recorded long-lasting burning of herbal dhoop with pleasant smell. Out of three formulations prepared, most liked Formulation was Formulation I liked by 80 % people, Formulation II by 15% and Formulation III by 5%. According to 94% people surveyed, this herbal dhoop was cost effective and doesn't have allergic effect on health than synthetic chemical-based mosquito repellents. This dhoop can be used for dual purpose as it has mosquito repellent property and also gives pleasant smell.

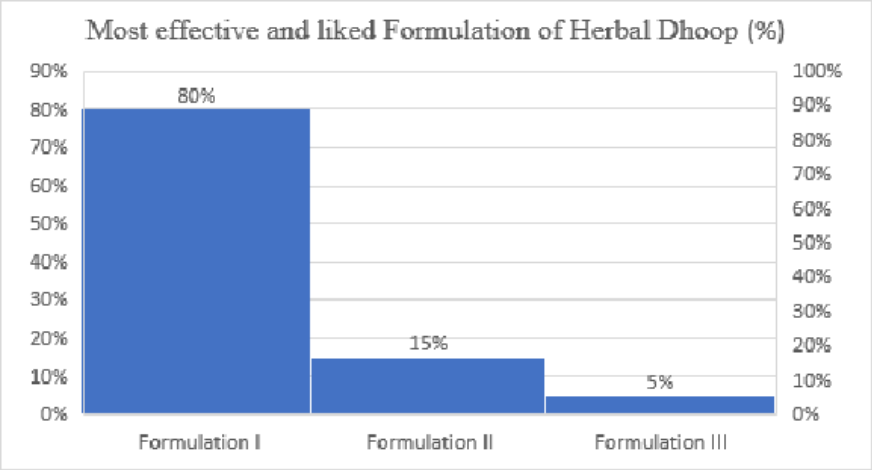

Fig. 1: Most effective and liked formulation of herbal mosquito repellent dhoop.

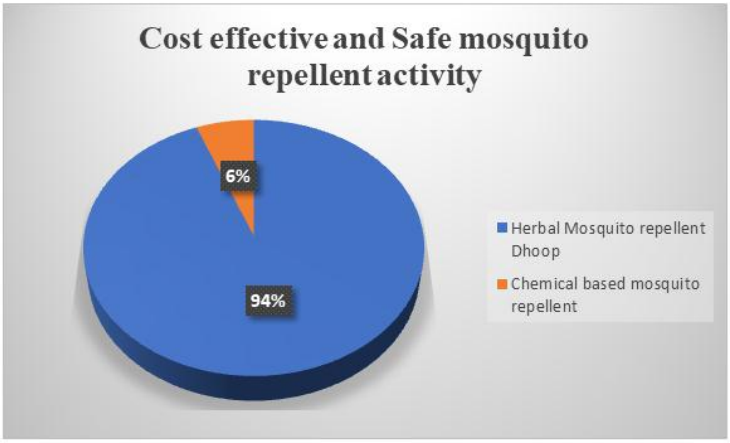

Fig.2: Comparison of Cost and Safe mosquito repellent activity of Herbal mosquito repellent dhoop and Chemical based mosquito repellent product.

IV. CONCLUSION

The present study reported that, plants with mosquito repellent activities provide equal protection from mosquitoes as compared to chemical mosquito repellents available in the market. Application of herbal mosquito repellents could help in reducing harmful effects of synthetic/chemical mosquito repellents. However, this prepared herbal mosquito repellent dhoop is safe, easy to use, cost effective and has maximum repellence activity against mosquitoes. This homemade dhoop has less adverse effect on the health of children and human beings. It is easy to formulate and doesn't require big investment and infrastructure and machinery. From the present study it was concluded that, Neem, Nirgudi, Turmeric, *Crysanthemum*, Clove, *Eucalyptus*, Orange peel, Holy basil, Marigold flowers and Camphor exhibit potential mosquito repellent properties.

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