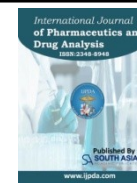




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Formulation and evaluation of eco-friendly handmade herbal mosquito repellent cone

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Abstract

A mosquito belongs to the insect-family *Culicidae*, order *Diptera*, suborder *Nematocera* and class *Insecta*. Mosquito act as vector which carries many disease causing parasites and viruses. Preventing mosquito spread is immensely necessary to stop spread of various contagious diseases. Now days, uses of plant based mosquito repellent have increased as synthetic repellents contains many noxious chemicals which can cause possible toxicity like skin toxicity and causes swelling, redness, itching and many health problems. The herbal mosquito repellent cones were prepared by using saw dust, cow dung, gum acacia, neem powder, eucalyptus powder and lemon grass powder. Lemon grass has insecticidal property. Saw dust increases the combustion. Gum acacia act as binder. Cow dung shows antioxidant and mosquito repellent property. Neem has mosquito repellent property. Herbal mosquito repellent cone were prepared by hand rolling method. The evaluation parameters of herbal mosquito repellent cone contain burning time (min), smoke visibility, odor, irritation test, ash weight (g.) and mosquito repellent activity. The formulation LNC containing lemon grass powder along with neem powder and cow dung in equal ratio shows best activity and maximum effectiveness in reducing mosquito number in comparison with all other formulations. In present study, the powders used in formulation were herbal based and eco-friendly and producing no side-effect on use. Here an attempt has been made to find out the novel formulation of different herbal plant powders containing alone and with combination for mosquito repellent cone.

Keywords: Mosquito repellent, contagious diseases, burning time.

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Introduction

Mosquito are one of the most disturbing and blood sucking organism that disturbs *Homo sapiens sapiens*[1]. Mosquito species included in the genera *Anopheles*, *Aedes* and *Culex* are vectors for the various disease pathogens like malaria, dengue fever, myiasis, yellow fever, encephalitis etc. The death rate increased to one million as of 2018, according to the American Association of Mosquito control. High fever and chills are its symptoms [2, 3, 4]. Mosquito work as a vector for

many deadly disorders that transfers the virus or parasite from one person to another person or in animals also [5]. Globally, mosquito borne diseases are increasing because of high rate of reproduction and development of resistance of insecticides in mosquito [6]. Both male and female mosquito survives on plant juice. Male mosquito do not bite human beings but the female mosquito suck human blood after mating as proteins is required for the maturation of eggs [7]. Chemical mosquito repellent have been extensively used to control the rate of mosquito either by killing or even preventing mosquito to bite the human beings or even killing mosquito's larvae at breeding sites [2]. Many of the plant extracts have beneficiary effect to health when consumed for longer time period. The oldest book of Hindu civilization is the Rig-Veda in India, written 5000 years ago. Much more higher and

modified use of plant material occurs in Atharvana Veda. Atharvana Veda had an Upaveda called Ayurveda. Charaka Samhita and Sushruta are famous treaties of Ayurveda. The Charaka Samhita includes 395 medicinal plants, 57 drugs of animal origin, 64 minerals as therapeutic agents [8]. Now days, mosquito have developed resistance which causes a need to develop an alternative method of mosquito control. For an effective formulation of repellent, one need check its toxicity problem which should match with the increased incidence of insect resistance. Globally, chemical larvicides are also used to control mosquito's population but these chemicals are toxic to humans, plants and animals.

According to WHO pesticide evaluation, major insecticides used in the Americas is the pyrethroids and organophosphates. Examples of chemical-based insect repellents used for mosquito are DEET [9] (N, N diethyl- m-toluamide) it is a registered pesticide, but possible side effects and warnings include: skin and eye irritation, insomnia etc. Permethrin, resmethrin and sumithrin are some synthetic pyrethroids used to kill adult mosquito. Many plant extract are also used in mosquito repellents. Researchers are finding that many plant based mosquito repellent not more effective than DEET [4] like Neem powder, eucalyptus powder etc [2].

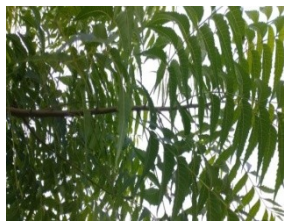


Butylated Hydroxy Toluene (B.H.T) - is an antioxidant, which cause hepatic or renal toxicity after ingestion or inhalation is used in various repellents.



Aerosols mosquito repellent damage the health and environment, also very expensive commercially and cause many harm to common people. Because of this reason one need to develop a safe herbal mosquito repellent [10, 11]. Plants based repellent work as emerging source for mosquito control and are used mainly to due to its insecticides or repellent properties. Plant powders are naturally occurring and have characteristic strong odor. Plant powder is generally green in color and has fine particles [2].

Advantages of herbal mosquito repellent

Non-poisonous, inexpensive, eco-friendly, easily available, non-irritant, easy to make, also act as insect repellent [12].

Table 1: Herbal Drug information used in preparation of Mosquito repellent.

S. No.	Plant Part	Medicinal Importance	Image
1.	Neem leaves (<i>Azadirachta indica</i>)	Anti-helmenthic, antifungal, antidiabetic, antibacterial, antiviral, contraceptive and sedative.	
2.	Lemon grass (<i>Cymbopogon citratus</i> L.)	Natural insect repellents	
3.	Eucalyptus leaves (<i>Eucalyptus globulus</i> L.)	Insecticide and miticide	

4.	Rose petals (<i>Rosa canina</i> L.)	Anti bacterial	
5.	Marigold (<i>Calendula officinalis</i> L.)	Insect repellent	

Materials

Raw material used for production of the herbal mosquito repellent cone were saw dust, cow dung, gum acacia, neem powder, eucalyptus powder and lemon grass powder. Different ingredients used in the preparation have different function.

Gum acacia is an excellent binder. Saw dust will enhance the combustion power. Lemon grass has medicinal property and insecticide ability. Cow dung smoke is potential antioxidant and also act as mosquito repellent. Neem has anti-viral and mosquito repellent property.

Plant powder and excipients used to make mosquito repellent cone

Dried Pyrethrum flower: Dried flower head of *Chrysanthemum cinerariifolium*. It is potent insecticidal, Neem: obtained from *Azadirachta indica* is a widely available plant with many good properties, neem is an excellent mosquito repellent, Lemon grass oil: obtained from *Cymbopogon nardus* plant. strong scent of it irritates the mosquito, Camphor: white and oily resin of the tree *Cinnamomum camphor* 13-16, *Acorus calamus*: Contains the compound β -asarone which has anti-feedant and larvicidal properties, Benzoin: The resin obtained from the aromatic tree *Styrax* genus. Its odour also repels mosquitoes, Joss/Jigat powder: Bark powder of the *Persea marcantha* tree, Gum acacia- used as a binder and Cow Dung: Anti-oxidant and mosquito repellent. Herbal drug information is given in Table 1.

Methods

Collection of leaves

Fresh leaves were collected from herbal garden of BN College of Pharmacy and after that washed with tap water and kept for air drying for 3 weeks.

Drying, grinding and screening of herbal powder

All dried leaves are subjected for grinding by using grinder mixer and after that screening of powder by help of sieves was performed. The powder should be very fine or else there would be problems in the binding and burning. The prepared raw material is shown in figure 1.



Figure 1: Wet mass and raw material for preparation of mosquito repellent cone.

Preparation of herbal mosquito repellent cone:

Weighed the dried powder individually and transferred in mortar and pestle, mixed well then water was gradually added to the fine powder until it attains wet mass (damp mass) like consistency. It should be well mixed and not too watery otherwise it creates problem in making cone. Cones were prepared by hand rolling method.

Same methods were followed for all formulation. Formulation information was given in table 2. The cones were dried for few hours under shade. Hot air oven at 50°C for 6 hrs can also be used to dry the cones faster (figure 2). Dried cone were then dipped in peppermint oil. Finally cones were packed in a airtight polybag and stored at room temperature (figure 3).



Figure 2: Drying of herbal cone in Hot air oven



Figure 3: Different formulation of herbal mosquito repellent cone

Table 2: various formulation containing herbal powder ingredients.

S.No.	Formulation no.	Herbal powder ingredients	Percentage
1	L	Lemmon grass	100%
2	E	Eucalyptus	100%
3	N	Neem	100%
4	LNE	Lemmon grass +Neem+ Eucalyptus	33.33% +33.33% +33.33%
5	LNC	Lemmon grass + Neem+ Cow dung	33.33% +33.33% +33.33%
6	EN	Eucalyptus + Neem	50% + 50%
7	LNEC	Eucalyptus + Lemon grass + Neem + Cow dung	25% +25% +25% +25%
8	LN	Lemmon grass + Neem	50% + 50%

Evaluation Parameters:

Burning time (minutes): Mosquito repellent cone from each formulation were burned and time was noted down.

Smoke visibility

Individually each mosquito repellent cone was burned and its smoke visibility was checked.

Odor

Individually each mosquito repellent cone was burned and its odor was checked.

Irritation test

Individually each mosquito repellent cone was burned and its irritancy was checked.

Ash weight (g.)

Ashes of each formulation were individually taken and carefully weight on weighing machine using butter paper.

Testing mosquito repellent activity of mosquito repellent cone using mosquito net cage method

About 20 mosquitos were transferred in the net cage. The mosquito repellent cones were burned in the room for 1 hour. Reduction in mosquito number was observed (table 3).

Results

The formulation LNC containing lemon grass, neem and cow dung shows the best result as mosquito repellent. The burning time was longest for this formulation when compared with all other formulation. Smoke visibility was also high. Aroma was also most pleasant. Ash weight was minimum for this formulation and shows maximum mosquito repellent activity when compared with other formulation.

Table 3: Evaluation parameters of herbal mosquito repellent cone

S. No.	Formulation no.	Burning time (minute)	Smoke visibility	Odor	Irritation test	Ash weight (g.)	Mosquito repellent activity (number)
1.	L	12	High	Satisfactory	No	0.89	2
2.	E	5	Low	Good	No	1.3	0
3.	N	8	High	Good	No	0.97	1
4.	LNE	18	High	Satisfactory	No	0.32	8

5.	LNC	35	High	Most Satisfactory	No	0.17	15
6.	EN	16	High	Good	No	0.53	4
7.	LNEC	25	Highest	Good	No	0.28	11
8.	LN	15	High	Satisfactory	No	0.57	3

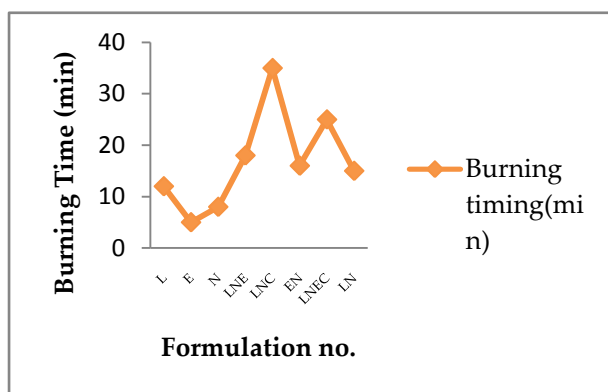


Figure 4: Burning timing of all formulation

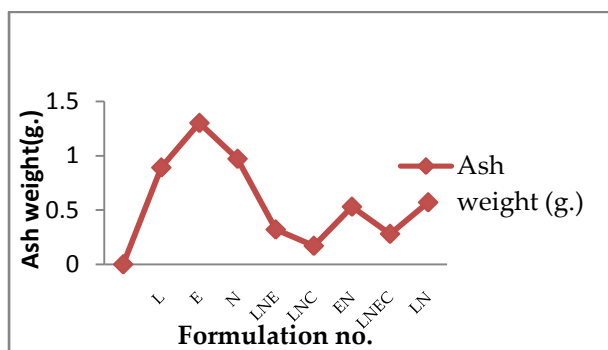


Figure 5: Ash weight (g.) of all formulation

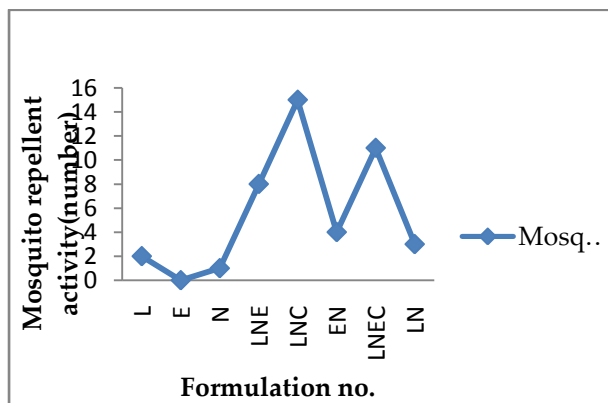


Figure 6: Mosquito repellent activity (number) of all formulation

Discussion

In this present research work, an attempt is done to prepare herbal mosquito repellent cone using saw dust and cow dung as fillers along with herbal powder of lemon grass, neem and eucalyptus. Also supporting excipients are added to the preparation. Here, different combination of herbal powder is tested as mosquito repellent cone. Some combination of herbal powder shows excellent property as mosquito repellent.

Evaluation parameters of herbal mosquito repellent cone are shown in Table 3. It contains burning time (minute), smoke visibility, odor, irritation test, ash weight (g.) and mosquito repellent activity. Smoke visibility shows the volume of smoke released from the mosquito repellent cone and gives an idea that natural mosquito repellent and natural pesticides is always better than synthetic preparations.

All eight formulations are also tested in mosquito affected areas. At burning time, it was observed that up to 95% of mosquito number was greatly decreased. Formulation LNC containing lemon grass powder along with neem powder and cow dung shows maximum effectiveness in reducing mosquito number when compared with all other formulation. Also aroma of this formulation was most satisfactory. Formulation LNEC also shows very good mosquito repellent property as here cow dung reduces the excessive irritancy caused by eucalyptus powder. Formulation LNE also shows good mosquito repellent property. That's why use of natural mosquito repellent cone is more holistic and better option than synthetic mosquito repellent cone as it is more effective as well as environmental friendly also.

Conclusions

Through present research paper work, it is revealed that lemon grass powder and neem powder shows very good mosquito repellent activity. So, Lemon grass along or in a combination can be used as a very good mosquito repellent. Many products can be made by using various combinations of lemon grass powder and neem powder like Spray, cream, liquidator, cone, candle and coil etc to get more effective mosquito repellent activity. By promoting more use of natural mosquito repellent, one can reduce the noxious effect of synthetic mosquito repellents on human health and environment. Also natural mosquito repellent is inexpensive, easy to use and easily available and shows maximum repellent activity against mosquito. Hand-made mosquito repellent cone are less harmful to health as compared with marketed synthetic coil. Through present research,

it is clearly seen that Lemon grass shows excellent mosquito repellent activity when used in combination with other herbal powders or alone. More stimulated test and trials are required for commercialization of mosquito repellent cone.

References

1. Makhaik M., Naik SN., Tewary DK. Evaluation of anti-mosquito properties of essential oils. J Sci Ind Res 2005; 64: 129-133
2. Mohomed AA., Tarek IAAM., Zarrag IAA. Larvicidal and repellent effect of some *Tribulus terrestris* L., (Zygophyllaceae) extracts against the dengue fever mosquito, *Aedes aegypti* (Diptera: Culicidae). J Saudi Soc 2012; 20: 13-16.
3. Karunamoorthi K, Ilango K. Larvicidal activity of *Cymbopogon citratus* (DC) Stapf. and *Croton macrostachyus* Del. against *Anopheles arabiensis* Patton (Diptera: Culicidae), the principal malaria vector. Eur Rev Med Pharmacol Sci. 2010;14 (1):57-62.
4. Chaiyakunapruk N., Kongkaew C., Sakunrag I., Tawatsin. Effectiveness of citronella preparations in preventing mosquito bites: systematic review of controlled laboratory experimental studies. Tropical Med Int Health 2011; 16: 802-810.
5. Gubler DJ. Resurgent vector-borne diseases as a global health problem. Emerging infectious diseases. 1998 Jul;4(3):442.
6. Madhumathy AP, Aivazi AA, Vijayan VA. Larvicidal efficacy of *Capsicum annum* against *Anopheles stephensi* and *Culex quinquefasciatus*. J Vector Borne Dis. 2007; 44:223-6.
7. Klowden MJ. Blood, sex, and the mosquito. Bioscience. 1995 May 1;45(5):326-31.
8. Frandin MS, Day JF. Comparative efficacy of insect repellents against mosquito bites. New England journal of Medicine 2002; 347: 13-18.
9. Braverman Y, Chizov-Ginzburg A, Mullens, BA. Mosquito repellent attracts *Culicoides imicola* (Diptera: Ceratopogonidae). Journal of Medical Entomology, 1999; 36(1): 113-115.
10. E.J. Mavundza, R. Maharaj, J.F. Finnie, G. Kabera, J. Van Staden An ethnobotanical survey of mosquito repellent plants in Mkhanyakude district, KwaZulu-Natal province, South Africa J Ethnopharmacol, 137 (2011), pp. 1516-1520.
11. S.Phasomkusolsil, M. Soonwera Insect repellent activity of medicinal plant oils against *Aedes aegypti* (Linn.), *Anopheles minimus* (Theobald) and *Culex quinquefasciatus* Say based on protection time and biting rate Southeast Asian J Trop Med Public Health, 41 (2010), pp. 831- 840.
12. EK. Patel, A. Gupta and RJ. Oswal, "A review on: mosquito repellent methods, international journal of pharmaceutical, chemical and biological sciences", 2012, 2(3), 310-317.
13. A.K. Mishra, N. Singh, V.P. Sharma Use of Neem oil as mosquito repellent in tribal villages of Mandla district, Madhya Pradesh Indian J Malariol, 32 (1995), pp. 99-103.
14. N.G.Das, D.R. Nath, I. Baruah, P.K. Talukdar, S.C. Das Field evaluation of herbal mosquito repellents J Commun Dis, 31 (2000), pp. 241-245.
15. Y.Young-Cheol, L. Eun-Hae, L. Hoi-Seon, L. Dong-Kyu, A. Young-Joon Repellency of aromatic medicinal plant extracts and a steam distillate to *Aedes aegypti* J Am Mosq Control Assoc, 20 (2004), pp. 146-149.
16. N.G. Das, Sunil Dhiman, P.K. Talukdar Synergistic mosquito-repellent activity of *Curcuma longa*, *Pogostemon heyneanus* and *Zanthoxylum limonella* essential oils J of Infection and Pub Health Vol 8, Issue 4, July-August 2015, pp 323-328.
17. Mendhekar Seema Yuvraj, Bodke Nikita Nivrutti, Thorat Pratik Bharat, S. L Jadhav, "formulation and evaluation of polyherbal mosquito repellent creams (ointment type) with extra skin nourishing impact", published in world journal of pharmacy and pharmaceutical sciences, 6(12), page no- 1735-1737.