FORMULATION AND EVALUATION OF HERBAL MOSQUITO REPELLENT CREAM

Prashant Jatkar[1]*, More Vrunal[2], Maniyar Mithun[3], Vishal Waghamare[4]

Abstract

The medicinal plants include a variety of biologically active components that aid in the prevention and treatment of a wide range of diseases. The essential oils have great fragrance and repellent activity. Mosquitoes bite can cause discomfort and transmit the vector diseases such as dengue fever or malaria that affected mankind. Mosquitoes are attracted human blood contains albumin to expand its balls and bite one human into another humans, thus transmitting the vector-borne disease to humans. This research is focused on the formulation and evaluation of herbal mosquito repellent composite to repelle mosquito from biting to human being. Topical mosquito repellent cream was formulated with varying concentractions of extracted essential oil. Formulated cream was evaluated for different parameters like pH, Spreadability, Washability, Mosquito repellent activity etc. The F3 formulation has good evaluation metrics and is effective against mosquitoes. The oil extracts in F3 formulations may have potential of mosquito repellent and it can be made into commercially available essence stick, gel formulation.

Keywords: Eucalyptus, Azadirachta indica, Marigold, Extracts, Cream, Mosquito repellent.

[1*,2,3,4]SVERI's College of Pharmacy, Gopalpur, Pandharpur-413304, Maharashtra

***Corresponding Author: -** Mr. Prashant Balasaheb Jatkar
*E-mail: pbjatkar@gmail.com

DOI: 10.48047/ecb/2023.12.si10.00252

1. Introduction

There are about 3500 different species of mosquito, and they're set up in tropical and tropical areas. Anopheles (filariasis, malaria), Culex (Japanese encephalitis, West Nile, chikungunya), and Aedes(chikungunya, dengue fever, and unheroic fever) are the main rubrics of mosquitoes that serve as vectors for multitudinous conditions[1]. Mosquitoes suck during day or night. They live outdoors and outside and begin to search for warm places as temperatures drop.The season for the mosquitoes generally starts in summer and continues till fall. Suck(s) from a mosquito can be further than just annoying or itchy. It can make one sick and in rare cases can begetdeath[2].In actuality, mosquito repellant does not kill mosquitoes. Repellents serve by making individualities less charming to mosquitoes, which reduces their liability of smelling people. When used duly, natural oil painting- grounded mosquito repellents are safe for grown-ups and children over the age of two months, according to the Environmental Protection Agency(EPA). There are multitudinous repellents on the request moment that effectively shield off mosquitoes but are bad for your health since they contain the poisonous chemical DEET[3].

Eucalyptus - Eucalyptus (Family-Myrtaceae), native to Australia, represented by about 700 species, is a genus of tall and beautiful evergreen trees grown worldwide for oil, rubber, pulp, timber, medicine and aesthetic value. The pesticidal effect of eucalyptus oils is based on components such as 1,8-cineole, citronellal, citronellol, citronellyl acetate, p-cymene, eucamalol, limonene, linalool, alpha-pinene, g-terpinene, alpha-terpineol, allocimene and aromatenderne[4].

Azadirachta indica- According to research, neem's most significant usage worldwide is as a pesticide. Numerous aromatic chemicals found in neem can be utilised to deter insects from attacking both humans and animals. Anopheles culicifacies mosquitoes were up to 98.03% protected against by neem oil and coconut oil mixture. Additionally, neem oil offered greater than 75% protection against A fluviatilis, Aedestaeniorhynchoides, and Mansonia uniformis[5].

Tagetes (Marigold) - It has a distinct odour that numerous insects find repulsive. The"a-terthienyl" chemical is to condemn for the odour. It gives marigold a erected- in insecticidal property. also, it contains pyrethrin, a natural substance that works well to repel mosquitoes. Marigold is known to repulse nematodes as well as some common nonentity pests. As a result, marigolds are constantly planted with tomatoes,chilli, andpotatoes.Pyrethrim, a constituent in multitudinous insect repellents, can be set up in flowers[6].

2. Material And Methods

2.1 Material

Leaves and other plant parts required were collected directly from the local market of Pandharpur, Maharastra and authenticated from botanical department of K.B.P. college, Pandharpur. All other chemicals were collected from Signet chemicals Pvt Ltd, Loba chemicals Pvt Ltd.

2.2 Preparation of Extraction

Air-dried leaves, flowers were ground just prior to extraction. The Ground leaves were placed in distilled water in a round bottom flask on a heater to prevent the plant components from overheating or being charred by direct steam[7]. One hundred grams (100 g) of plant material was mixed with 800 ml of distilled water distillation process was performed for 3 h, and the obtained essential oil was collected[8]. Extracted essential oil was dried over anhydrous sodium sulfate(Na_2SO_4) to remove all the water and then stored it in dark-sealed-vial at 4°C for further tests[7].

2.3 Formulation of mosquito repellent cream

Table 1. Formulation concentration of repellent cream

Ingredient	F1	F2	F3
Eucalyptus oil	1.5%	3.5%	5.5%
Neem Oil	2%	4%	6%
Marigold	1.5%	3.5%	5.5%
Camphor	0.5gm	1gm	1.5gm
Cetyl alcohol	2 %	2 %	2 %
Lanolin	1%	1%	1%
Mineral oil	2 %	2 %	2 %
Stearic acid	15%	15%	15%
Glycerine	10%	10%	10%
Pot. Hydroxide	1%	1%	1%
Preservative	Q.S.	Q.S.	Q.S.
Water	Q.S	Q.S.	Q.S.

2.4 Procedure

Lanolin, stearic acid, cetyl alcohol, mineral oil, propyl paraben, in oil phase etc. were combined with glycerine, potassium hydroxide, etc. in the water phase to create the oil in water type cream. Heat was applied to the aqueous and oil phases till 75°C.After heating, the oil phase was gradually added to the aqueous phase while being continuously stirred to create a homogeneous cream. Essential oils were added after complete emulsification when the temperature dropped to 55°C to 60°C [9].

Fig 1. Formulated cream

2.5 Evaluation

2.5.1 Evaluation of extracted oil

Fourier Transform Infra-red Spectroscopy (F.T.I.R)

FT-IR spectrophotometer (JASCO FTIR-410) was used to perform Fourier Transform Infrared Spectroscopy Of oil samples. The spectra were scanned with a resolution of 4 cm-1 spanning the wavelength range of 4000 to 400 cm^{-1}.The process involved distributing a sample of KBr and compressing it into a disc using a hydraulic press at a pressure of 5 tonnes for 5 minutes. The spectrum was acquired after the oil was exposed to the light[9].

2.5.2 Evaluation of herbal mosquito repellent Cream

2.5.2.1 Organoleptic Characteristics

Colour, texture, physical appearance of cream was evaluated[10]**.**

2.5.2.2 pH

The pH of various formulations was determined by using digital pH meter. About 1 g of the cream was weighed and dissolved in 100 ml of distilled water and stored for two hours. The measurement of pH of each formulation was done in triplicate and average values were calculated[11].

2.5.2.3 Spreadability

The Spreadability was measured in terms of how long it took two slides operating under a specific load to separate from the cream positioned in between the slides. Better spreadability results from faster separation of the two slides. Glass slides with uniform dimensions were selected from two sets. On one of the slides, the herbal cream mixture was applied. The cream was sandwiched between the two slides after the other slide was placed on top of the formulation. Weight was applied to the upper slides to evenly press the cream between them, forming a thin coating. The excess formulation that was sticking to the slides was scraped off once the weight was removed. Due to the weight that was attached to it, the upper slide allowed for unrestricted slipping off. It was noted how long the upper slide took.

Spreadability = m× l /t

Where,

m=Weight tied to upper slide (30gm)

l = (5 cm) length of glass slide

t = amount of time in seconds[12].

2.5.2.4 Washability

A small amount of cream was applied on the hand and it is then washed with tap water[13].

2.5.2.5 Extrudability

In this technique, the standard-capped collapsible aluminium tube was filled with the herbal cream formulation and the end was crimped shut to seal it. The mass of the tube was captured. The tube was clamped after being positioned between two glass slides. The slides were covered with a 500 g weight, and the cap was taken off. The extruded cream's volume was gathered and weighed [14].

2.5.2.6 Irritancy test

Test area was marked about (1sq.cm) on the left hand dorsal surface. The cream was applied to the specified area and time was noted. Irritancy, erythema, edema, was checked if any for regular intervals up to 24 hrs and reported[15].

2.5.2.7 Viscosity

For rheological tests, a Brookfield Viscometer (Model RVT) with helipath stand was employed. The sample (50 g) was put in a beaker and given 5 minutes to acclimatise before the dial reading was measured using a T-D spindle at 10, 20, 30, 50, 60, and 100 rpm. The dial reading on the viscometer was recorded for each speed. The dial reading that corresponded to each decrease in spindle speed was recorded. At room temperature, the measurements were made in triplicate. The viscosity in centipoises was obtained by directly multiplying the dial readings by the coefficients listed in the Brookfield viscometer catalogue. A three-triplicate average was calculated[16].

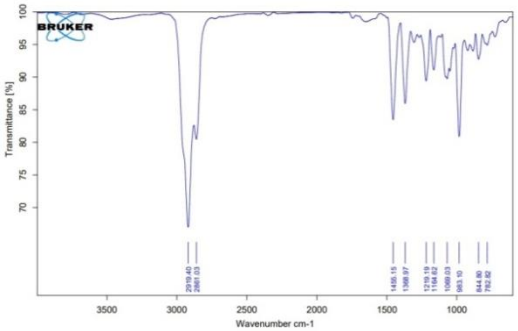
2.5.2.8 Evaluation of mosquito repellent activity

Method employs a glass-frame cage with a wooden bottom, screened top and back, clear acrylic sides (for viewing), and a front for access. Mosquitoes are placed in the cage before the test. The treated hand is inserted into the cage (a glove is used to protect the hand from mosquito bites.) and the number of mosquitoes repells is observed for 10 min and recorded [9].

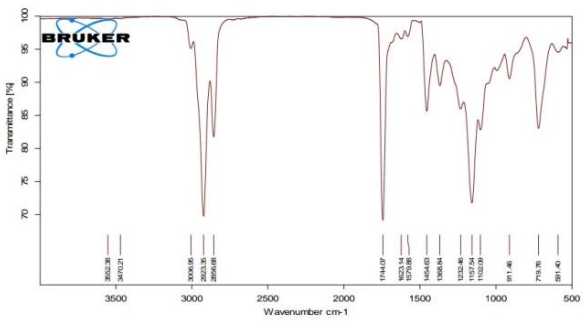
Fig 2. Evaluation of mosquito repellent activity

3. Results

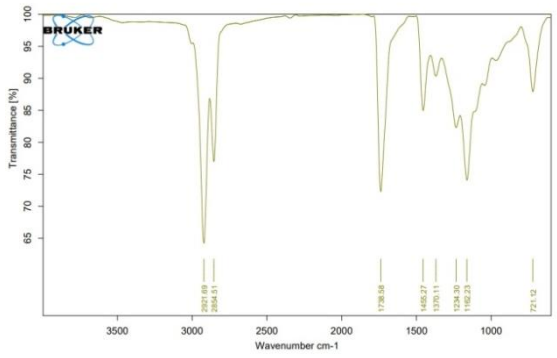
3.1 Results of extracted oils



(a)



(b)



(c)

Fig 3. (a) FT-IR spectrum of Eucalyptus oil. (b) FT-IR spectrum of Marigold oil. (c) FT-IR spectrum of Azadirachta indica oil

3.1.1 Eucalyptus oil: IR spectrum of Eucalyptus oil shows characteristic peaks at1164.62, 2919.40,2861.03, 1455.15, 782.2, 844.80

Table 2. FT-IR results of Eucalyptus oil

Sr no.	Bond	Functional group	Frequency
1	C-O-C stretch	Ether	1164.62
2	-C-H aliphaticstretching	Alkyl group	2919.40, 2681.03
3	-C-H bend	Alkyl Group	1455.15
4	Ring substitution	Para, meta disubstituted ring	782.2, 844.80

3.1.2 Marigold oil: IR spectrum of Marigold oil shows characteristic peaks at1744.07, 1102.09, 3006.95, 2923.35, 1454.63, 719.76, 3552.38, 1623.14

Table 3. FT-IR results of Marigold oil

Sr.no	Bond	Functional group	Frequency
1	-C=O	Ketone	1744.07
2	C-O-C stretch	Ether	1102.0
3	-C-H aliphatic stretching	Alkyl Group	3006.95, 2923.35
4	-C-H bend	Alkyl Group	1454.63
5	Ring substitution	Monosubstituted ring	719.76
6	-OH stretching	Alcohol	3552.38
7	C=C stretch	Aromatic ring conjugated double bond	1623.14

3.1.3 Azadirachta indica oil: IR spectrum of Azadirachta indica oil shows characteristic peaks at1738.58, 1162.23, 2921.69, 1455.27, 721.12

Table 4. FT-IR results of Azadirachta indica oil

Sr.no	Bond	Functional group	Frequency
1	-C=O	Ketone	1738.58
2	C-O-C stretch	Ether	1162.23
3	-C-H aliphatic stretching	Alkyl Group	2921.09
4	-C-H bend	Alkyl Group	1455.27
5	Ring substitution	Monosubstituted ring	721.12

3.2 Evaluation of Formulated Cream

Table 5. Evaluation of Cream

Sr No.	Evaluation	F1	F2	F3
1	**Physical Appearance**	Opaque	Opaque	Opaque
2	**Color**	Pale yellow	Pale yellow	Pale yellow
3	**Texture**	Smooth	Smooth	Smooth
4	**Homogeneity**	Homogeneous	Homogeneous	Homogeneous
5	**Immediate Skin Feels**	Moisturizing, no grittiness, light	Moisturizing, no grittiness, light	Moisturizing, no grittiness, light
6	**pH**	6.12	6.10	6.15
7	**Spreadability g.cm/s**	13.63	16.6	18.75
8	**Washability**	Easily Washable	Easily Washable	Easily Washable
9	**Extrudability (%)**	70	73.6	78.8
10	**Viscosity at 10 rpm (CPS)**	2845	3290	3315

3.2.1 Organoleptic Characteristics

The organoleptic characteristics like appearance, colour, texture etc was evaluated and results are as per Table 5

3.2.2 pH

pH of all the formulations were found to be between 6.10 to 6.15 that is within the range, which are presented in the Table 5. Although alkaline, this pH is typical of creams acceptable by the all standards

3.2.3 Spreadability

The spreadability of all formulations wasfound between 13.63 to 18.75 g.cm/s and it was observed that formulation F3 has greater spreadability value as compared to other formulations.

3.2.4 Washability

The washability of all formulations was determined. All formulations are easily washable.

3.2.5 Extrudability

The extrudability of all formulations was determined and it was observed that all formulation shows good extrudability. The extrudability of all formulation was carried out in percentage (%) and formulation F3 has greater extrudability as compared to other formulations.

3.2.6 Determination of viscosity

Viscosities of all the formulations were noted and found in the range of 2845 to 3315 CPS at 10 rpm as shown in table. All the formulations were showed pseudo plastic flow.

3.2.7 Irritancy test

The irritancy test of all formulations was determined and it was observed for Irritancy, erythema, edema. All the formulation does not show any Irritancy, erythema, edema.

3.2.8 Mosquito repellent activity

Table 6. Mosquito repellent activity

Formulation no.	Parameter	Control	Test 1	Test 2
F1	Number of Mosquitoes	10	10	10
	Number of mosquitos respells	0	04	05
	Repellent activity	No	Yes	Yes
	Observation Time (min)	10	10	10
	Temperature ^0C	28	28	28
F2	Number ofmosquitoes	10	10	10
	Number of mosquitos respells	0	05	07
	Repellent activity	No	Yes	Yes
	Observation Time (min)	10	10	10
	Temperature ^0C	28	28	28

F3	Number of Mosquitoes	10	10	10
	Number of mosquitos respells	0	08	09
	Repellent activity	No	Yes	Yes
	observation Time (min)	10	10	10
	Temperature ^0C	28	28	28

4. Conclusion

Although the history of DEET and other well-known repellents like dimethyl phthalate is established, it is true that the blend of various essential oils affects repellent effectiveness. According to the current study, natural, non-DEET formulations can be employed as insect repellents.The results are positive and promising. The formulation F3 demonstrated highest repellant activity. Finally, it was determined that oil extracts have the potential to be a mosquito repellent and can be made into a commercial product such as an essence stick, a lotion that repels insects, etc

5. References

1. Ghosh A, Chowdhury N, Chandra G. Plant extracts as potential mosquito larvicides. Indian J Med Res. 2011; 135(46):581-598.
2. https://www.cdc.gov/features/stopmosquitoes/index.html, last accessed on 28th May, 2018.
3. Nikam Mangesh Maruti, More V.V, Design and Development of Mosquito Repellent Formulation Containing Carom Seed, International Journal of Scientific Research in Science and Technology, Vol 7 Issue 5,88-94
4. Daizy R. Batish, Harminder Pal Singh, Ravinder Kumar Kohli ,Shalinder Kaur, Eucalyptus essential oil as a natural pesticide, Forest Ecology and Management 256 (2008) 2166–2174
5. Ibrahim SI, Fakhraddeen YM, Hauwa UA,mosquito repellent activity of leaf and seed extract of azadirachta indica (neem),2019,19-23
6. Nayan Ponkiya, Shreya Desai, Jemisha Mistry, Swetal Patel, Rajashekhar Ingalhalli, Development of economical mosquito repellent using marigold plant, IJRTI, 2018, Volume 3, issue 11, 47-54
7. Mahtab Samadi, Zurina Zainal Abidin, Robiah Yunus , Dayang Radiah, Assessing the kinetic model of hydro-distillation and chemical composition of Aquilaria malaccensis leaves essential oil, Chinese Journal of Chemical Engineering,2016,1-7
8. Kehinde Oluwakemi Fagbemi, Daniel Ayandiran Aina and Olufunmiso Olusola Olajuyigbe, Soxhlet Extraction versus Hydrodistillation Using the Clevenger Apparatus: A Comparative Study on the Extraction of a Volatile Compound from Tamarindus indica Seeds, Hindawi The Scientific World Journal,2021,1-8
9. Nikam Mangesh Maruti, More V. V., Design and Development of Mosquito Repellent Formulation Containing Carom Seed, International Journal of Scientific Research in Science and Technology,2020,Volume 7,Issue 5,Page Number: 88-94
10. Dr. Sneha Agrawal, Nidhi Haldankar, Nidhi Haldankar, Formulation of Natural Mosquito Repellent, International Journal of Advance Research, Ideas and Innovations in Technology, 2018, Volume 4, Issue 1,11-17
11. Ashwini, S. D., Somishwar, S. K. and Shweta, S. S. Formulation and evaluation of vanishing herbal cream of crude drugs. American J. Ethnomedicine., 2014; 1(5): 313-318.
12. Anuradha Keshwar, Unmesh Keshwar, Ashwini Deogirkar, S. S. Dhurde, Veena Deo and B. K. Shrikhande, Formulation Development and Evaluation of Cream Containing Natural Essential Oils having Mosquito Repellent Property, World Journal of Pharmacy And Pharmaceutical Sciences, Volume 5, Issue 8, 1586-1593.
13. Sk Uddandu Saheb, Aduri Prakash Reddy, K Rajitha, B Sravani, B Vanitha. Formulation and evaluation of cream from naturally containing plant extracts. World J Pharm Pharm Sci 2018;7:851-62.
14. Shivani Dattatray Khatal, A. K. Salunkhe, Formulation and Evaluation of Antibacterial Herbal Vanishing Cream, Int. J. Pharm. Sci. Rev. Res., 77(1), November - December 2022; Article No. 13, Pages: 75-79
15. N. R. Patel, H. U. Momin, R. L, Dhumal, K. L Mohite, Preparation and evaluation of multipurpose herbal cream, Adv pharm Life sci Res,2017;5(1):27-32
16. Mei X. Chen, Kenneth S. Alexander and Gabriellla Baki, Formulation and evaluation of antibacterial creams and gels containing metal ions for topical applications, Hindavi publishing corporation Journal of

Pharmaceutics Volume 2016:1-11