ISSN 2456-3110
Vol 8 · Issue 5
May 2023

JAiMS
INTERNATIONAL

Journal of Ayurveda and Integrated Medical Sciences

www.jaims.in

JAIMS

An International Journal for Researches in Ayurveda and Allied Sciences

Maharshi Charaka
Ayurveda

Indexed

Journal of
Ayurveda and Integrated Medical Sciences
ISSN 2456-3110
ORIGINAL ARTICLE May 2023

Larvicidal activity of essential oils of *Haridra* and *Tulsi* against *Aedes aegypti* and *Anopheles* larvae

Akshu Sharma[1], Manisha Dikshit[2], AC Pandey[3], Raj Kumar Singh[4], Praful Dikshit[5]

[1]*Assistant Professor, Dept. of Agad Tantra. SKSS Ayurvedic Medical College & Hospital, Sarabha Ludhiana, Punjab, India.*

[2]*Associate Professor, PG Dept. of Agad Tantra. Uttarakhand Ayurvedic University, Rishikul Campus, Haridwar, Uttarakhand, India.*

[3,4]*Research Scientists, ICMR NIMR, BHEL, Haridwar, Uttarakhand, India.*

[5]*Research and Statistics Consultant, Haridwar, Uttarakhand, India.*

ABSTRACT

An attempt is made in the present study to analyse the larvicidal activity of *Haridra* and *Tulsi* against *Aedes* and *Anopheles* larvae. Larval bioassays were carried out at different concentrations 50-500ppm. The larval mortality of fourth instar larvae of *A. aegypti* and *Anopheles* after 24h of treatment was observed separately in control, 50, 62.5, 100, 150, 250, 300 and 500 ppm concentrations. Based on the Probit analysis, Significant effect (Estimate adh_conc = 3.069, 95% C.I. [2.082, 4.057], z = 6.093, p<.05) of *Haridra oil* extract concentration for *Aedes* (adh_conc) on the Probit response or mortality was observed. The median lethal Concentration, LC50= 166.353, 95% C.I. [134.745, 203.268], 90% Lethal Concentration, LC90 = 435.065, 95% C.I. [328.259, 712.462] were recorded. Statistical analysis revealed that significant effect (Estimate adt_conc = 3.369, 95% C.I. [2.229, 4.509], z = 5.791, p<.05) of *Tulsi oil* extract on *Aedes larvae* concentration (adt_conc) on the Probit response or larvae mortality (adt_mort) was observed. The median Lethal Concentration, LC50= 105.051, 95% Confidence Intervals (C.I). [81.451, 127.428], 90% Lethal Concentration, LC90 = 252.242, 95% C.I. [199.229, 376.772] of essential oil of *Tulsi oil* against *Aedes aegypti* larvae was recorded. No mortality of *Aedes* larvae was recorded in the control group. Larvicidal activity of both the plants against *Aedes* larvae at different concentration was significant. But LC_{50} and LC_{90} values of *Ocimum sanctum (Tulsi)* against mortality of *Aedes aegypti* were less as compared to *Curcuma longa (Haridra)*. It revealed that *Tulsi* showed better larvicidal activity against *Aedes* larvae as compared to *Haridra.* It was also observed that LC_{50} and LC_{90} values of *Haridra* against *Anopheles* larvae were less than *Tulsi*. It revealed that *Haridra* showed better larvicidal activity against *Anopheles* larvae as compared to *Tulsi.*

Key words: *Mosquito larvicidal activity, Haridra, Tulsi, Aedes aegypti, Anopheles.*

INTRODUCTION

Mosquitoes are the most disturbing insects and are very hazardous to humanity. A single mosquito bite can cause many deadly diseases and many vector-borne diseases. Dangerous diseases like Dengue, Chikungunya, Malaria, Filariasis, Japanese Encephalitis, etc. spread through several mosquito species of the genera *Aedes*, Culex & Anopheles. Dengue is also undoubtedly one of the biggest health concerns in India.[1] NVBDCP data shows that 2017 was an even worse year: 1.88 lakh people were diagnosed with dengue and 325 were dead. NVBDCP data also reveals that over one lakh people were diagnosed and an estimated 172 people died from dengue in 2018.[2] According to the World Malaria Report 2018 of WHO, the data from 2015-2017 highlighted that no significant progress in reducing global malaria cases was made in this period. There were an estimated 219 million cases and 4, 35,000 related deaths in 2017.[3] In India, according to National Vector Borne Disease Control Programme in Uttarakhand in 2019 (prov) till November there were 10,500 cases and 8 deaths.[4] Additionally, it has been

Address for correspondence:
Dr. Akshu Sharma
Assistant Professor, Dept. of Agad Tantra. SKSS Ayurvedic Medical College & Hospital, Sarabha Ludhiana, Punjab, India.
E-mail: drrajakshusharma@gmail.com

Submission Date: 13/03/2023 Accepted Date: 18/04/2023

Access this article online

Quick Response Code

Website: www.jaims.in

DOI: 10.21760/jaims.8.5.3

ISSN: 2456-3110 ORIGINAL ARTICLE May 2023

found that mosquitoes tend to develop resistance to many synthetic insecticides (S.R. Yankanchi et.al; 2014).[5] This study aims to provide better potency and efficacy through essential oils extracts of herbs, which are known to show improved individual as well as synergistic effects. (Sarath Mangalat et.al; 2004, Shivaji Kasthe et.al; 2015).[6] *Haridra* is described in *Agni Purana*. *Haridra* was used in the treatment of *Prameha, Arsha, Kamala*, and *Vrana Ropan*. In *Atharvaveda*, it is used for the treatment of *Kushth*. Various *Nighantus* have mentioned synonyms of *Haridra* like *Krimighna, Jantughna,* and *Vishghna* and effective against *Krimi* [insects].[7] Curcumin (diferuloylmethane) and various volatile oils, including turmerone, atlantone and zingiberene, are Poly phenolic curcuminoids, Pharmacological actions of *Haridra* [*Curcuma longa*] are antimicrobial activity, antiviral activity, antifungal activity. *Tulsi* has been classified in the classical Nighantus and Samhitas of Ayurveda under different *Gana* or *Varga* (groups). Properties of *Tulsi* are mentioned as *Vish-nashak* in many Ayurvedic texts, as well as *Keet-Vish Nashak* properties in various formulations. The chemical composition of *Tulsi* [*Ocimum sanctum*] is a volatile oil, phenolic compounds, flavonoids Aesculectin, Aesculin, Stearic acid Aromadendrene oxide, Benzaldehyde, etc. The pharmacological actions of *Tulsi* [*Ocimum sanctum*] are antimicrobial activity, anti-inflammatory activity, and antipyretic activity.[8] By selecting these two plants due to their properties we have taken these plants for our study.

Materials and Methods

Plants of *Haridra* and *Tulsi* were collected from Palampur, H.P, and Shirish were collected from Rishikul Haridwar.The Plants identification was done in the department of Dravyaguna, Rishikul Campus Haridwar.Essential oils of the plant materials were extracted by Clevenger Apparatus.The Clevenger apparatus was named after its inventor, Joseph Franklin Clevenger, WHO published in 1928. Parts of Clevenger Apparatus: 1. Heating mantle 2. Round bottom flask 3. Condenser 4. Clevenger part 5. Water inlet and water outlet.

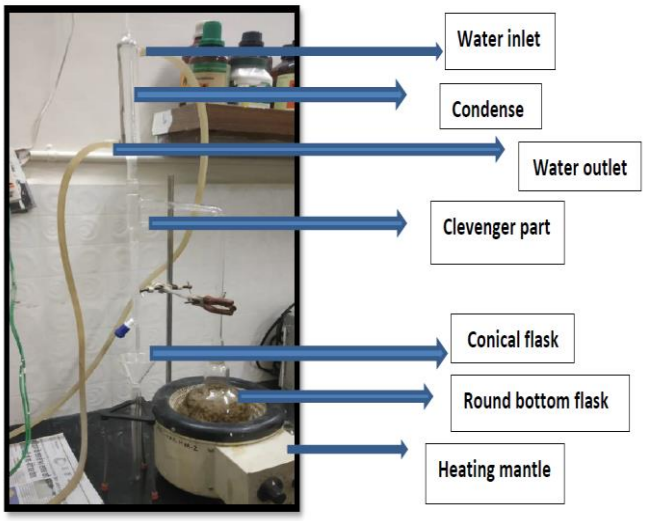


Fig. 1: Clevenger Apparatus[9]

Samples Preparation

Rhizomes (Roots) parts of the *Haridra*, leaves of *Tulsi* and bark of Shirish were taken for the extraction of the essential oils. The plant materials were washed with distilled water to remove dust particles and shade dried. Essential oils of the plants were obtained by the hydro-distillation method. In Clevenger apparatus, the raw material of the shade dried was subjected to water distillation in a Clevenger apparatus for 7 h. The oil layer is separated from the aqueous phase using n-hexane with the help of a separating funnel. The anhydrous sodium sulfate is added in hexane-oil solution to remove water content absorbed by hexane. The oil is obtained by removal of n-hexane at low temperature and the samples were kept in a refrigerator at 4ºC.

Yield of essential oils of *Haridra* (*Curcuma longa*) rhizome paste and *Tulsi* (*Ocimum sanctum*) leaves

Essential oils of *Curcuma longa* (Haldi) rhizome paste and *Ocimum sanctum* (*Tulsi*) leaves were obtained by hydro-steam distillation by Clevenger extraction methods for 4-7 hour daily for several days. A total of 250 gm of the plant materials of each plant was extracted in which 0.2gm of *Curcuma longa* and 0.1gm of *Ocimum sanctum* were obtained, which yielded 1 gm of essential oil of *Curcuma longa* and 0.5 gm of essential oil of *Ocimum sanctum* after 5 times of extraction. % Yield of essential oils of *Curcuma longa*

ISSN: 2456-3110 ORIGINAL ARTICLE May 2023

(Haldi) rhizome paste and *Ocimum sanctum* (*Tulsi*) leaves is given in table 1.

Table 1: Yield of essential oils of *Haridra* (*Curcuma longa*) rhizome paste and *Tulsi* (*Ocimum sanctum*) leaves.

Name of plants	Amount of plant materials extracted in per extraction (gm)*	Total amount of plant materials extracted (gm)	Total Yield of essential oils	% yield
Curcuma longa (Haldi) rhizome paste	50	250 gm	1gm	0.4
Ocimum sanctum (*Tulsi*) leaves	50	250 gm	0.5 gm	0.2

*Plant material was extracted for 4 hour in Clevenger apparatus daily for several days.

Field collection of mosquito larvae and their rearing in laboratory

Mosquito larvae of *Aedes* and Anopheles were collected from breeding sites in different areas in Haridwar, BHEL Sector 4,5, Roadways Bus Service Station, Haridwar, Old Industrial Area of district Haridwar, Near Nigam Office, Haridwar, Village Bhogpur Tall of Chilla range, District Pauri Garhwal The larvae were brought to the laboratory and the collected mosquito larvae were identified at the Field Unit of The National Institute of Malaria Research; Haridwar. The collected mosquito larvae were brought to the laboratory and kept in the laboratory at 26±20C. The larvae were provided a mixture of dog biscuit and yeast powder in a 3:2 ratio as nutrients. The larvae were reared in the laboratory up to the 3rd and 4th instars for testing of larvicidal activity.

Bioassays test for determination of larvicidal activity

Bioassay test for determination of larvicidal activity of essential oils of the plants was performed on late 3rd and early 4th stage larvae of Anopheles and *Aedes*. Larvicidal activity of *Haridra* and *Tulsi* was performed alone at 500 ppm, 300 ppm, 250 ppm, 150 ppm,100 ppm 62.5 ppm, and 50 ppm. Twenty mosquitoes were released into larvae. Twenty larvae of different mosquito species were placed into a 500 ml glass beaker/ bowl containing 250 ml of water. 0.1ml essential oil of the plant was dissolved in 1ml ethanol. Essential oil dissolved in ethanol was added to a 500ml glass beaker containing 250 ml at different concentrations. The mosquito larvae were exposed to different concentrations of essential oil. The test larvae were provided a mixture of dog biscuit and yeast powder in a 3:2 ratio as nutrients. Mortality of larvae was monitored within 24 hours of the exposure. All the tests were carried out in 3 replicates along with the untreated control. Data were recorded and analyzed.

Observation and Results

Larvicidal efficacy of essential oil of *Haridra* against *Aedes aegypti* larvae

Results of larvicidal activity of essential oil of *Curcuma longa* against *Aedes* larvae at different concentration is given in table-2. It was observed that 100 % mortality of *Aedes* larvae was observed at concentration of 500 ppm. Thereafter % mean mortality were 71.0 (range: 70.0-75.0), 65.0 (range: 60.0-75.0), 46.0 (40.0-50.0), 23.0 (40.0-50.0), 13.0 (10.0- 15.0), 0 at concentration of 500, 300, 250, 150, 100, 62.5, 50.0 ppm respectively at 24 hour exposure of the larvae. No mortality of *Aedes* larvae were recorded in control group.

Table 2: Larvicidal activity of essential oil of *Curcuma longa* (Haldi) against *Aedes*

Concentration (ppm)	Replicates	No. of larvae exposed	Mortality of larvae in 24 hour (Nos.)	Percent mortality in 24 hr.	% corrected mortality in 24 hr.	Mean % corrected Mortality (Range)*
500	R-1	20	20	100	100	100
	R-2	20	20	100	100	
	R-3	20	20	100	100	

ISSN: 2456-3110 ORIGINAL ARTICLE May 2023

300	R-1	20	14	70	70	71 (70-75)
	R-2	20	15	75	75	
	R-3	20	14	70	70	
250	R-1	20	12	60	60	65 (60-75)
	R-2	20	12	60	60	
	R-3	20	15	75	75	
150	R-1	20	10	50	50	46 (40-50)
	R-2	20	10	50	50	
	R-3	20	8	40	40	
100	R-1	20	5	25	50	23 (40-50)
	R-2	20	4	20	50	
	R-3	20	5	25	40	
62.5	R-1	20	2	10	10	13 (10-15)
	R-2	20	3	15	15	
	R-3	20	3	15	15	
50	R-1	20	0	0	0	0
	R-2	20	0	0	0	
	R-3	20	0	0	0	
Control	R-1	20	0	0	0	0
	R-2	20	0	0	0	
	R-3	20	0	0	0	

Larvicidal efficacy of essential oil of *Ocimum sanctum* against *Aedes aegypti* larvae:

Results of larvicidal activity of essential oil of *Ocimum sanctum* against *Aedes* larvae at different concentration is given in table-3. 100 % mortality of *Aedes* larvae was observed at concentration of 500 ppm. Thereafter % mean mortality were 95.0 (range: 90.0-100.0), 88.0 (range:85.0-90.0), 63.3 (range: 60.0-70.0), 46.0 (range:40.0-50.0) 10.0, 0 at concentration of 500, 300, 250, 150, 100, 62.5, 50.0 ppm respectively at 24 hour exposure of the larvae. No mortality of *Aedes* larvae were recorded in control group.

Table 3: Larvicidal efficacy of essential oil of *Tulsi (Ocimum sanctum)* against *Aedes aegypti* larvae.

Concentration (ppm)	Replicates	No. of larvae exposed	Mortality of larvae in 24 hour (Nos.)	Percent mortality in 24 hr.	% corrected mortality in 24 hr.	Mean % corrected Mortality (Range)*
500	R-1	20	20	100	100	100
	R-2	20	20	100	100	
	R-3	20	20	100	100	
300	R-1	20	19	95	95	95 (90-100)
	R-2	20	20	100	100	
	R-3	20	19	95	90	
250	R-1	20	18	90	90	88 (85-90)
	R-2	20	18	90	90	
	R-3	20	17	85	85	
150	R-1	20	14	70	70	63.3 (60-70)
	R-2	20	12	60	60	
	R-3	20	12	60	60	
100	R-1	20	10	50	50	46 (40-50)
	R-2	20	10	50	50	
	R-3	20	08	40	40	
62.5	R-1	20	5	5	10	10
	R-2	20	5	5	10	
	R-3	20	6	6	10	
50	R-1	20	0	0	0	0
	R-2	20	0	0	0	
	R-3	20	0	0	0	
Control	R-1	20	0	0	0	0
	R-2	20	0	0	0	
	R-3	20	0	0	0	

ISSN: 2456-3110 ORIGINAL ARTICLE May 2023

Larvicidal efficacy of essential oil of *Haridra* against *Anopheles* larvae.

Results of larvicidal activity of essential oil of *Haridra* against *Anopheles* larvae at different concentration is given in table-4. It was observed that percent mean mortality of *Anopheles* larvae was 86.0 (range: 80.0-100.0), 81.0 (range: 70.0-90.0), 60.0 (range: 55.0-65.0), 46.0 (range: 40.0-50.0) 30.0, 0 at concentration of 500, 300, 250, 150, 100, 62.5, 50.0 ppm respectively at 24 hour exposure of the larvae. No mortality of *Aedes* larvae were recorded in control group.

Table 4: Larvicidal activity of essential oil of *Haridra* (*Curcuma longa)* against *Anopheles.*

Concentration (ppm)	Replicates	No. of larvae exposed	Mortality of larvae in 24 hour (Nos.)	Percent mortality in 24 hr.	% corrected mortality in 24 hr.	Mean % corrected Mortality (Range)*
500	R-1	20	18	80	80	86 (80-100)
	R-2	20	18	80	80	
	R-3	20	20	100	100	
300	R-1	20	14	70	70	81 (70-90)
	R-2	20	16	85	85	
	R-3	20	19	95	90	
250	R-1	20	11	55	55	60 (55-65)
	R-2	20	12	60	60	
	R-3	20	13	65	65	
150	R-1	20	11	55	55	58 (55-60)
	R-2	20	12	60	60	
	R-3	20	12	60	60	
100	R-1	20	10	50	50	46 (40-50)
	R-2	20	10	50	50	
	R-3	20	8	40	40	
62.5	R-1	20	5	30	30	30
	R-2	20	5	30	30	
	R-3	20	6	30	30	
50	R-1	20	0	0	0	0
	R-2	20	0	0	0	
	R-3	20	0	0	0	
Control	R-1	20	0	0	0	0
	R-2	20	0	0	0	
	R-3	20	0	0	0	

Larvicidal efficacy of essential oil of *Tulsi* against *Anopheles* larvae

Results of Preliminary study of larvicidal efficacy of *Tulsi* extract oil against *Anopheles* larvae are shown in table-5. Results of larvicidal activity of essential oil of *Tulsi* against *Anopheles* larvae at different concentration is given in table-5. Mean percent mortality were 65.0 (range: 55.0-70.0), 51.0 (range: 55.0-55.0), 33.0 (range:25.0.0-40.0), 18.0 (range:15.0-20.0) 15.0 (range:10.0-15.0), 6.0 (range:5.0-10.0), 0 at concentration of 500, 300, 250, 150, 100, 62.5, 50.0 ppm respectively at 24-hour exposure of the larvae. No mortality of *Anopheles* larvae was recorded in control group.

Table 5: Larvicidal activity of essential oil of *Tulsi* (*Ocimum sanctum)* against *Anopheles.*

Concentration (ppm)	Replicates	No. of larvae exposed	Mortality of larvae in 24 hour (Nos.)	Percent mortality in 24 hr.	% corrected mortality in 24 hr.	Mean % corrected Mortality (Range)*
500	R-1	20	14	70	70	65 (55-70)
	R-2	20	11	55	55	
	R-3	20	14	70	70	
300	R-1	20	10	50	50	
	R-2	20	11	55	55	

ISSN: 2456-3110 ORIGINAL ARTICLE May 2023

	R-3	20	10	50	50	51 (50-55)
250	R-1	20	8	40	40	33 (25-40)
	R-2	20	7	35	35	
	R-3	20	5	25	25	
150	R-1	20	4	20	20	18 (15-20)
	R-2	20	3	15	15	
	R-3	20	4	20	20	
100	R-1	20	3	15	15	15 (10-15)
	R-2	20	2	10	10	
	R-3	20	2	10	10	
62.5	R-1	20	2	25	10	6 (5-10)
	R-2	20	1	30	5	
	R-3	20	1	25	5	
50	R-1	20	0	0	0	0
	R-2	20	0	0	0	
	R-3	20	0	0	0	
Control	R-1	20	0	0	0	0
	R-2	20	0	0	0	
	R-3	20	0	0	0	

Statistical Analysis

The Probit model for *Haridra* oil extract on *Aedes* larvae successfully converges and finds an optimal solution after 14 iterations. The Higher the number of iterations, the higher the variability in the relationship represented by the Probit model, thus, greater attempts are required by the system to arrive at the maximum likelihood of mortality probability. Significant effect (Estimate adh_conc = 3.069, 95% C.I. [2.082, 4.057], z = 6.093, p<.05 of *Haridra* oil-extract concentration for *Aedes* (adh_conc) on the Probit response or mortality was observed. The median lethal Concentration, LC50= 166.353, 95% C.I. [134.745, 203.268], 90% Lethal Concentration, LC90 = 435.065, 95% C.I. [328.259, 712.462] were recorded. The results are graphically depicted in Figures 2.1 and 2.2.

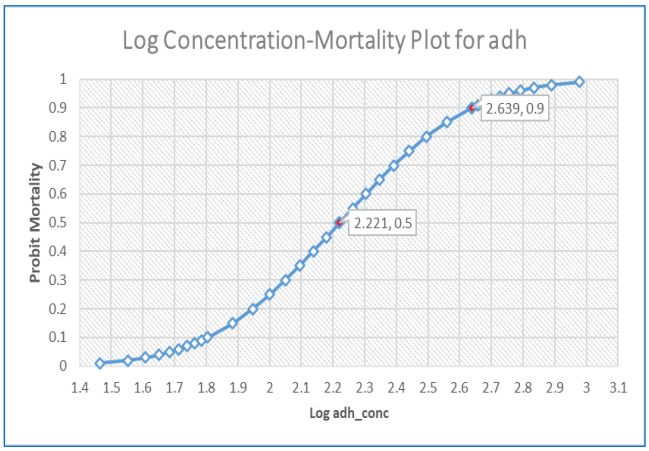


Fig. 2.1: Log Concentration-Mortality Plot of essential oil of *Haridra* against *Aedes aegypti* larvae.

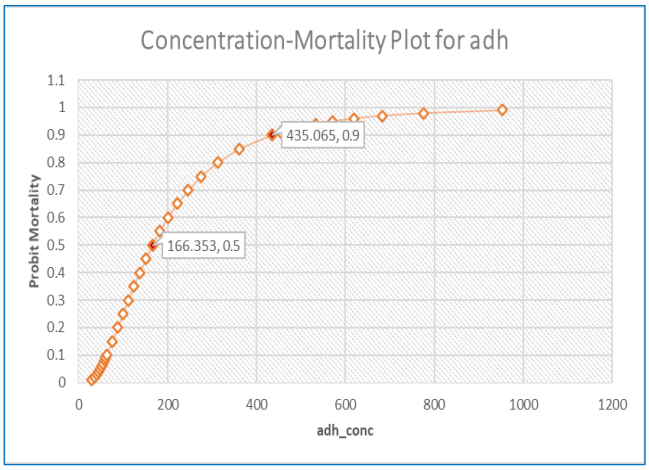


Fig. 2.2: Log Concentration-Mortality Plot of essential oil of *Curcuma longa* against *Aedes aegypti* larvae.

Statistical analysis revealed that significant effect (Estimate adt_conc = 3.369, 95% C.I. [2.229, 4.509], *z* = 5.791, *p*<.05) of *Tulsi* oil-extract on *Aedes* larvae concentration (adt_conc) on the Probit response or larvae mortality (adt_mort) was observed. The median Lethal Concentration, LC_{50}= 105.051, 95% Confidence Intervals (C.I). [81.451, 127.428], 90% Lethal Concentration, LC_{90} = 252.242, 95% C.I. [199.229, 376.772] of essential oil of *Ocimum sanctum* against *Aedes aegypti* larvae was recorded. The results are graphically depicted in Figures 3.1 and 3.2.

ISSN: 2456-3110 ORIGINAL ARTICLE May 2023

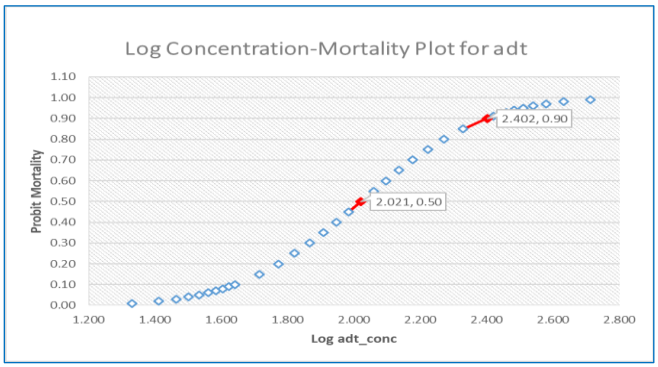


Fig. 3.1: Log Concentration-Mortality Plot of essential oil of *Ocimum sanctum* against *Aedes aegypti* larvae.

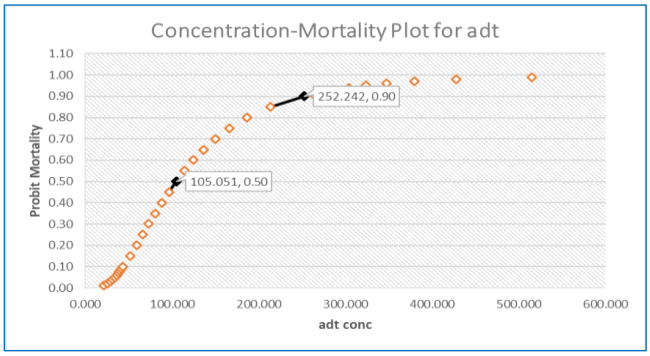


Fig. 3.2: Concentration-Mortality Plot of essential oil of *Ocimum sanctum* against *Aedes aegypti* larvae.

Essential oil of *Haridra* at different concentration shows a significant effect (Estimate anh_conc = 2.038, 95% C.I. [1.180, 2.896], z = 4.655, p<.05) against mortality of *Anopheles* Larvae on the Probit response or mortality. The median Lethal Concentration, LC_{50} = 124.823, 95% Confidence interval CI. [84.002, 164.336], 90% Lethal Concentration, LC_{90} = 530.978, 95% C.I. [349.474, 1333.827] of essential oil of *Curcuma longa* against *Anopheles* larvae was recorded. The results are graphically depicted in Figures 4.1 and 4.2.

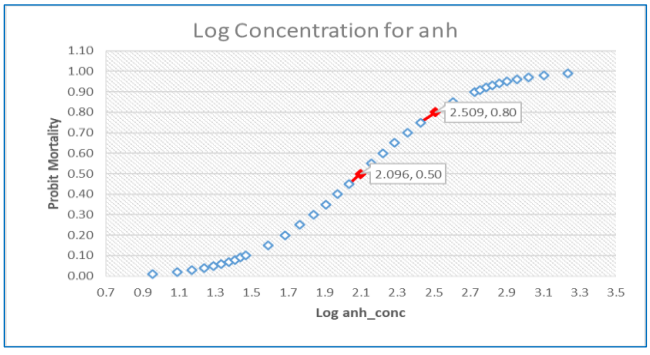


Fig. 4.1: Log Concentration-Mortality Plot of essential oil of *Curcuma longa* against *Anopheles* larvae.

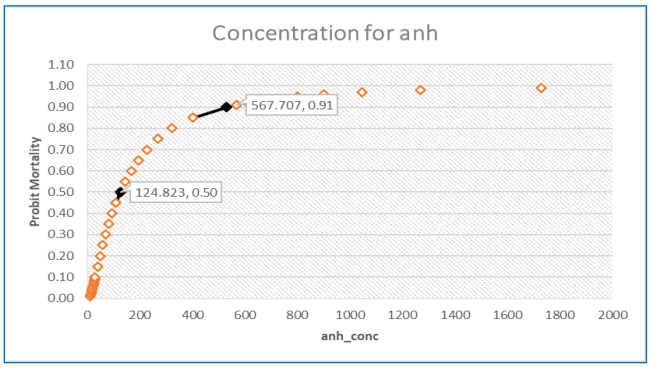


Fig. 4.2: Concentration-Mortality Plot of essential oil of *Curcuma longa* against *Anopheles* larvae.

Significant effect (Estimate ant_conc = 2.257, 95% C.I. [1.135, 3.200], z = 4.694, p<.05) of *Tulsi* oil-extract on *Anopheles* Larvae concentration (ant_conc) on the Probit response or mortality (ant mort) was observed.Median Lethal Concentration, LC_{50} = 339.419, 95% Confidence Interval (C.I.) [259.239, 533.727], 90% Lethal Concentration, LC_{90} = 1254.519, 95% C.I. [717.77, 4574.12] of essential oil of *Ocimum sanctum* against *Anopheles* larvae were calculated. The results are graphically depicted in Figures 5.1 and 5.2.

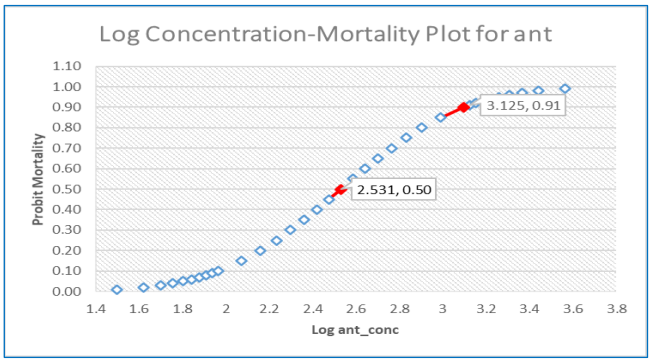


Fig. 5.1: Log Concentration-Mortality Plot of essential oil of *Ocimum sanctum* against *Anopheles* larvae.

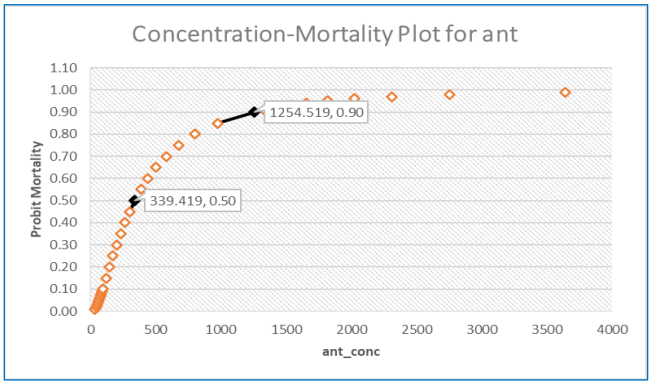
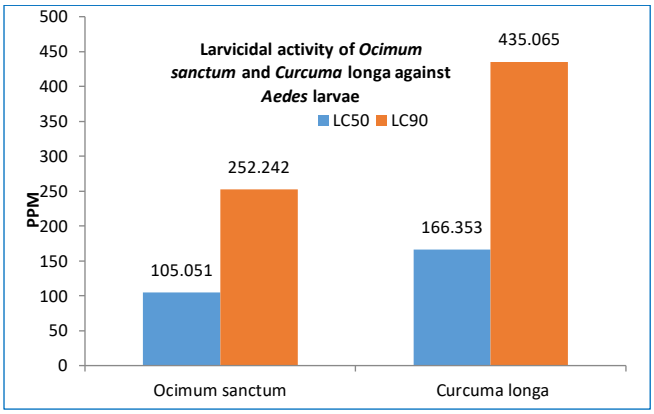


Fig. 5.2: Concentration-Mortality Plot of essential oil of *Ocimum sanctum* against *Anopheles* larvae.

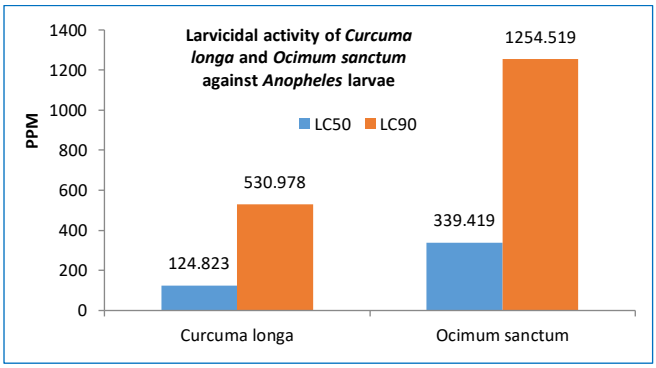
ISSN: 2456-3110 ORIGINAL ARTICLE May 2023

Discussion

Larvicidal activity of both the plants against *Aedes* larvae at different concentration was significant. But LC_{50} and LC_{90} values of *Ocimum sanctum (Tulsi)* against mortality of *Aedes aegypti* were less as compared to *Curcuma longa (Haridra)*. It revealed that *Tulsi* showed better larvicidal activity against *Aedes* larvae as compared to *Haridra.*



It was observed that LC_{50} and LC_{90} values of *Haridra* against *Anopheles* larvae were less than *Tulsi*. It revealed that *Haridra* showed better larvicidal activity against *Anopheles* larvae as compared to *Tulsi.*



References

1. www.mosquitoworld.net
2. https://nvbdcp.gov.in
3. http://www.who.int/mediacentre/factsheets/en/
4. https://timesofindia.indiatimes.com/city/dehradun/uk hand-records-757-dengue-casesin-just-4-months/articles show.
5. S.R.Yankanchi, Omkar V. Yadav and Ganesh S. Jadhav. Synergistic and individual efficacy of certain plant extracts against dengue vector mosquito, *Aedes* aegypti. 2014.
6. Sarath Mangalat, Varun Narayanan and Minija Janardhanan. Herbal larvicides to control mosquito larvae. Jawaharlal Nehru higher secondary school mahe-673310, Pondicherry. 2004.
7. Bibekananda Pandey. Agnipuran. Part-2, Ist Edition, Delhi.1997.
8. Singh S. and Majumdar D.K. (1997). Evaluation of anti-inflammatory activity of fatty acids of *Ocimum sanctum* fixed oil. Indian J Exp Biol. 35:380-383.
9. Akshu Sharma, Manisha Dikshit, Amita Jhunjhunwala, Ashwani K. Som. Extraction process of *Haridra* & *Tulsi* essential oil with their medicinal uses. Dept. of Agad Tantra Evum Vidhi Vaidyak, Uttarakhand Ayurveda University, Rishikul Campus, Haridwar, Uttarakhand, India.

How to cite this article: Akshu Sharma, Manisha Dikshit, AC Pandey, Raj Kumar Singh, Praful Dikshit. Larvicidal activity of essential oils of Haridra and Tulsi against Aedes aegypti and Anopheles larvae. J Ayurveda Integr Med Sci 2023;05:13-20.
http://dx.doi.org/10.21760/jaims.8.5.3

Source of Support: Nil, **Conflict of Interest:** None declared.

****