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Original Article

Evaluation of natural oils for the development of cheap and sustainable solution for mosquito problem in the poor community

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ABSTRACT: Mosquitoes and their increasing number are responsible for causing millions of deaths around the world. Another important aspect is global warming that has already altered the distribution of vector borne diseases (IPCC fourth assessment report). Uses of synthetic insecticides to control vector mosquitoes has not only affected humans but has also caused adverse environmental effects in addition to high operational cost. Chemical mosquito repellent has a remarkable safety profile, but they are toxic to human health causing various side effects. Hence giving importance to health of human beings together with the environment, a mosquito repellent solution was prepared. The solution was prepared using the natural oils such as neem (*Azadirachta indica*), lemon grass (*Cymbopogon flexuosus*). All the oils were experimented using different concentrations. The experiment was conducted in a society where the people were already suffering from vector borne diseases such as malaria, dengue and chikungunya. The solution proved to be very effective for repelling of the mosquitoes and also did not cause any effect on the human beings. In addition to this, the solution is affordable by the poor communities.

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INTRODUCTION

Controlling mosquitoes is of utmost importance in the present-day scenario with rising number of mosquito borne diseases. An alarming increase in the range of mosquitoes is mainly due to deforestation, stagnant water and lack of awareness among the people. Environmental changes are also causing an increase in the number and spread of many vectors worldwide mainly due to global warming. This has led to increase in the number of vector borne diseases causing rise in the mortality rate of the human beings. The vector borne diseases that spread through mosquito are malaria, dengue, Chikungunya, Yellow fever. One of the deadliest mosquitoes which are *Aedes* mosquito, are highly invasive and can survive almost any climatic conditions Some mosquitoes are also ecologically beneficial for their contribution to biodiversity, food chains, pollination, and only some species are sources of threat to human and animal health because of their role as vectors of disease pathogen.

As the vector thrives under conditions where housing is poor, water is unsafe, and environment is contaminated with filth, these diseases exact their heaviest toll on the poor. Measures that control the vector, the agents of diseases, provide an excellent, but underutilized opportunity to help this people catch up. The coils used include pollutants characterized like fine and ultrafine particles, PAHs, VOCs, and aldehydes, with high irritation or suspected carcinogenic effects. The exposure to the mosquito coil smoke poses both acute and chronic health risks (Weili Liu, Mosquito Coil Emissions and Health Implications) [2]. But the main challenge was how to keep the count on the mosquitoes and these has been overcome by using yeast as a source of carbon dioxide to trap mosquitoes [5, 13]. Citronella grass, Neem oil has been serving from years as a mosquito repellent in the field of ancient and modern medicine [7,11,12].

The oils were already proved that they had a mosquito repelling property but their efficiency was not known. By studying the efficiency of these essential oils used for spraying to control the mosquitoes is one of the best approaches to strengthen vector control. Controlling of the mosquitoes by essential oil spraying can make a major contribution to poverty reduction, as it precisely targets the poor. This will invigorate vector control and give it high profile it deserves. The main objective of this research is to produce and check the efficiency of the organic and novel product which is eco-friendly and cost efficient for the poor community.

MATERIALS AND METHODS

Sampling Location: The study area chosen was Natvar Parekh Compound (NPC), Shivaji Nagar, Govandi East, Mumbai-400043, Maharashtra, India. It is the slum rehabilitation site by the government comprising of more than 12000 residents, located 19°3'50.12"N and 72°54'58.53"E. The distance between 2 buildings is approximately 10feet. The population here is mostly of slum dwellers, ignorant towards the importance of cleanliness. The people in the area have a practice of dumping garbage in between the gaps of two buildings which has become an open dumping ground which has led to the breeding of the mosquito. Also, was this location selected, as the people here were suffering from vector borne diseases and the no of people being infected by the vector borne diseases was increasing. There were no proper precautions taken from society too. Since the site consists of poor communities, there were no proper precautionary measures taken by them. So as to reduce the infection of vector borne diseases as well as to procure good health for the residents, the project was executed.

Survey: A questionnaire based survey was conducted for the residents where they were questioned about their health conditions, hygiene practices, general awareness on vector borne diseases and lifestyle habits. Also, their response towards chemically synthesized mosquito repellent was noted in terms of effectiveness and affordability. Based on the collected data the conclusion was made that these available chemical mosquito repellents were not affordable for the community and also were a few subjects reporting effects on the respiratory health. Simultaneously communication was made with the Municipal Ward Office's Pest Control Officer under whose supervision regular vector control schemes were active in the area.

Preparation of the mosquito repellent spray: The concentration of the selected oils for mosquito repellent activities was kept to 1% and ethyl alcohol was used as the solvent for the final solution. A 10 ml solution was prepared using distilled water and the bottles were distributed to the subject for testing. The testing solution was made using NEEM OIL, LEMONGRASS OIL and a combination of both.

The Venue & Preliminary Testing: After conducting the survey, the initial stage was mosquito trapping. This was essential to know the presence of mosquitoes as well as the reduction in their number in the study area, after using essential oil spray. The method used here was solution-based where the solution was prepared by using water, caramelised sugar and activated yeast in pet bottles. Carbon dioxide produced during the reaction, works as an attractant for the mosquitoes.



The selected building at NPC consists of seven floors. Each floor has 12 flats, thus making 84 flats per building. The arrangement of the buildings is very compact which makes light penetration to the lower floors very difficult. Thus post 4th floor the amount of light received is highly reduced. This results in higher exposure to mosquito's even during the morning hours.

The preliminary test was done on different floors in the building to identify the reach of mosquitoes based on floor levels, and also different diameters for mouth of the pet bottle were experimented to observe any variation in the trapping activity.

Two different oils (Lemongrass and Neem) and their combination were used to test the effectiveness of its repellence on mosquitoes. For trapping the mosquitoes, the testing was done in three stages:

Initial Stage: In this stage, the mosquito traps were kept at dark places inside the house as well as in the balcony to trap the mosquitoes present at both the locations. Readings were taken for every 24 hours for three days. Readings included counting of the mosquitoes in both the mosquito traps at both location i.e in the house as well as in the balcony. No mosquito repellent sprays were used throughout the initial stage.

Test Stage: (Along with the mosquito traps.) Residents were told to spray the mosquito repellent solution (lemongrass, neem, lemon grass+neem oil) inside the house as well as in the balcony at two times a day i.e. morning, evening (evenly distributed by hours). Readings were taken for every 24 hours for three days. The decrease in the number of mosquitoes indicated the effectiveness of the mosquito repellent sprays at both the locations.

Final Stage: Only mosquito traps were kept at the dark places inside the house as well as outside the house in the balcony. No spraying of the mosquito repellent was allowed. Readings were taken for every 24 hours for 5 days. In this readings the no. of the mosquito trapped were counted which signified as to how long the spray was effective after discontinuing the mosquito repellent sprays.

The essential oils such as Neem and Lemongrass oils and with their combination were tested as a repellent spray against mosquitoes. The results have shown that essential oils have insecticidal properties and can be used as powerful tool against mosquitoes.

Neem oil:

RESULTS

Table 1: Initial stage: (The represented data shows number of mosquitoes trapped)

Name (Resident)	Flat No/ Wing	Pre-Test Readings (No. of mosquitoes present in 24 hours)					
		Day 1 (Inside)	Day 1 (Outside)	Day 2 (Inside)	Day 2 (Outside)	Day 3 (Inside)	Day 3 (Outside)
Afrin Usmani	5C/1flr	18	30	20	25	33	35
Abdul Shaikh	5B/1flr	15	22	16	27	21	28

Table 2: Test Stage: (With the repellent spray)

Name	Flat No/ Wing	Test Readings (No. of Mosquitoes Present In 24 Hours)					
		Day 1 (Inside)	Day 1 (Outside)	Day 2 (Inside)	Day 2 (Outside)	Day 3 (Inside)	Day 3 (Outside)
Afrin Usmani	5C/1flr	3	15	2	13	0	17
Abdul Shaikh	5B/1 flr	3	19	2	16	1	14

Table 3: Final stage: (Represents the trapped mosquitoes post discontinuing the spraying activity)

Name	Flat no/ Wing	Post-Test Reading (No. Of Mosquitoes Present In 24 Hours)									
		Day 1 (In)	Day 1 (Out)	Day 2 (In)	Day 2 (Out)	Day 3 (In)	Day 3 (Out)	Day 4 (In)	Day 4 (Out)	Day 5 (In)	Day 5 (Out)
Afrin Usmani	5C/1FLR	0	22	0	25	3	30	13	29	13	34
Abdul Shaikh	5B/1 FLR	0	24	0	26	3	26	15	27	15	29

Lemongrass oil

Table 4: Initial stage: (The represented data shows number of mosquitoes trapped.)

Name (resident)	Flat No/ Wing	Pre-Test Readings (No. of Mosquitoes present in 24 Hours)					
		Day 1 (Inside)	Day 1 (Outside)	Day 2 (Inside)	Day 2 (Outside)	Day 3 (Inside)	Day 3 (Outside)
Nushrat Shaikh	6B/1flr	16	28	38	27	14	24
Salma Shaikh	10C/1 flr	14	27	25	26	19	26

Table 5: Test stage: (With the repellent spray)

Name	Flat No/ Wing	Test Readings (No. of Mosquitoes present in 24 Hours)					
		Day 1 (Inside)	Day 1 (Outside)	Day 2 (Inside)	Day 2 (Outside)	Day 3 (Inside)	Day 3 (Outside)
Nushrat Shaikh	6B/1 st flr	3	20	3	19	2	18
Salma Shaikh	10C/1 st Flr	4	23	2	22	0	20

Table 6: Final stage: (Represents the trapped mosquitoes post discontinuing the spraying activity)

Name	Flat no/ Wing	Post-Test Reading (No. of Mosquitoes present in 24 Hours)									
		Day1 (In)	Day 1 (Out)	Day 2 (In)	Day 2 (Out)	Day 3 (In)	Day 3 (Out)	Day 4 (In)	Day 4 (Out)	Day 5 (In)	Day 5 (Out)
Nushrat Shaikh	6B/1 st Flr	2	21	1	24	4	29	14	26	14	31
Salma Shaikh	10C/1 st Flr	1	26	1	20	3	31	17	29	17	29

Lemongrass oil + Neem oil:

Table 7: Initial stage: (The represented data shows number of mosquitoes trapped.)

Name	Flat No/ Wing	Pre-Test Readings (No. of Mosquitoes Present in 24 Hours)					
		Day 1 (Inside)	Day 1 (Outside)	Day 2 (Inside)	Day 2 (Outside)	Day 3 (Inside)	Day 3 (Outside)
Zafar Khan	10B/1 st flr	14	23	29	24	22	5

Table 8: Test stage: (With the repellent spray)

Name	Flat No/ Wing	Test Readings (No. of Mosquitoes present in 24 Hours)					
		Day 1 (Inside)	Day 1 (Outside)	Day 2 (Inside)	Day 2 (Outside)	Day 3 (Inside)	Day 3 (Outside)
Zafar Khan	10B/1 st Flr	3	16	1	17	2	18

Table 9: Final stage: (Represents the trapped mosquitoes post discontinuing the spraying activity)

Name	Flat no/ Wing	Post-Test Reading (No. of Mosquitoes present in 24 Hours)									
		Day 1 (In)	Day 1 (Out)	Day 2 (In)	Day 2 (Out)	Day 3 (In)	Day 3 (Out)	Day 4 (In)	Day 4 (Out)	Day 5 (In)	Day 5 (Out)
Zafar Khan	10b/1 Flr	0	25	0	26	2	27	12	28	12	26

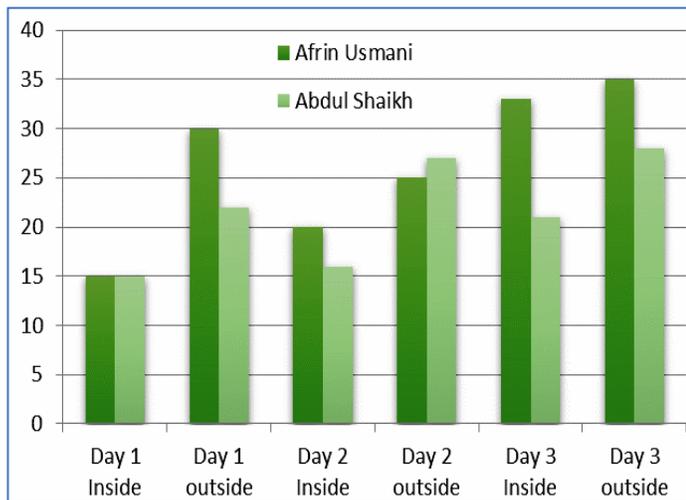


Figure 1: graphical representation of initial stage

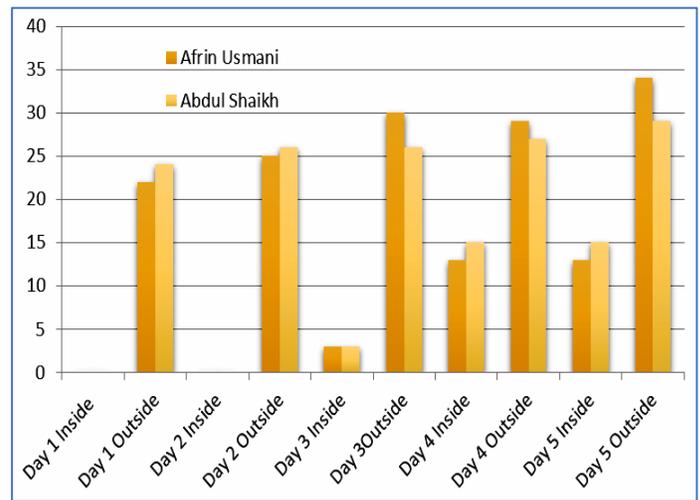


Figure 3: graphical representation of the final stage

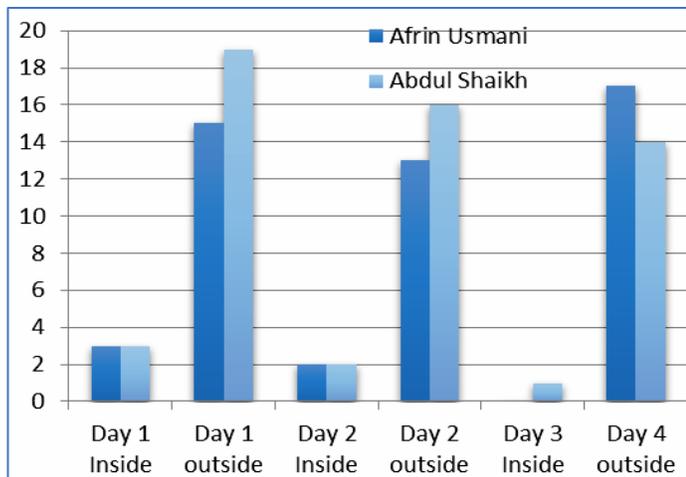


Figure 2: graphical representation of the test stage

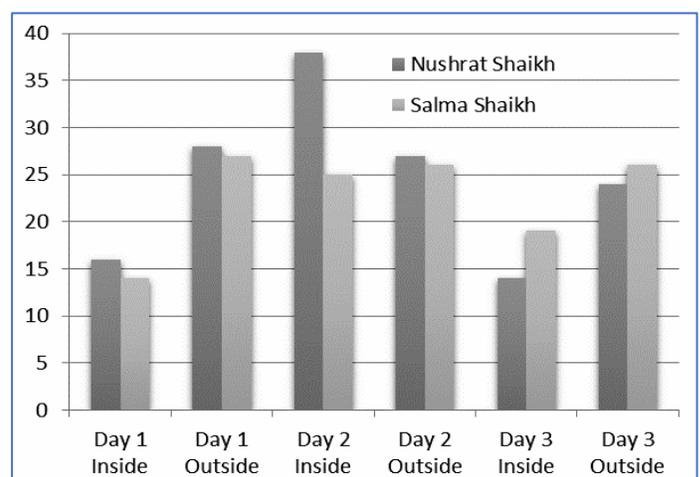


Figure 4: graphical representation of initial stage

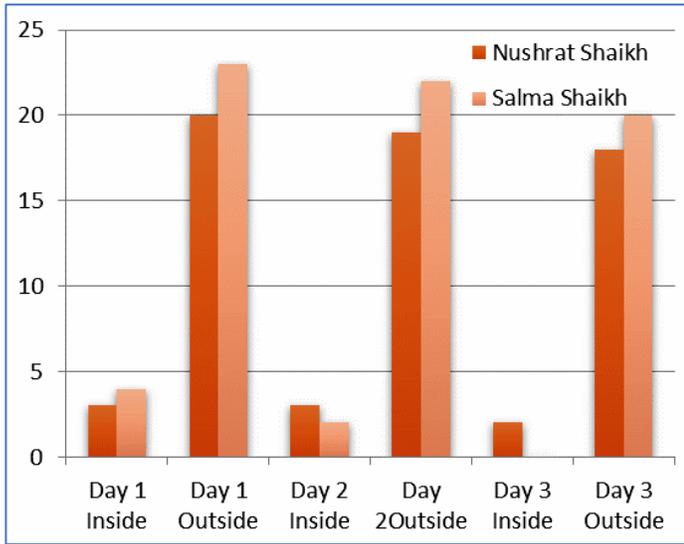


Figure 5: graphical representation of the test stage

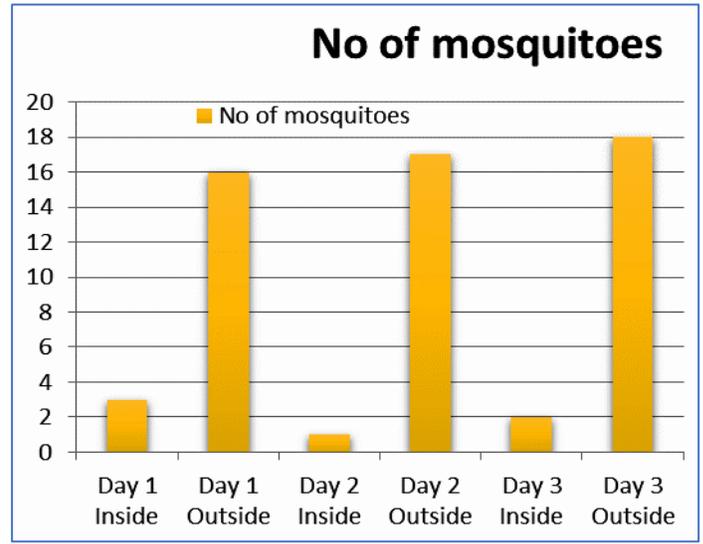


Figure 8: graphical representation of test stage

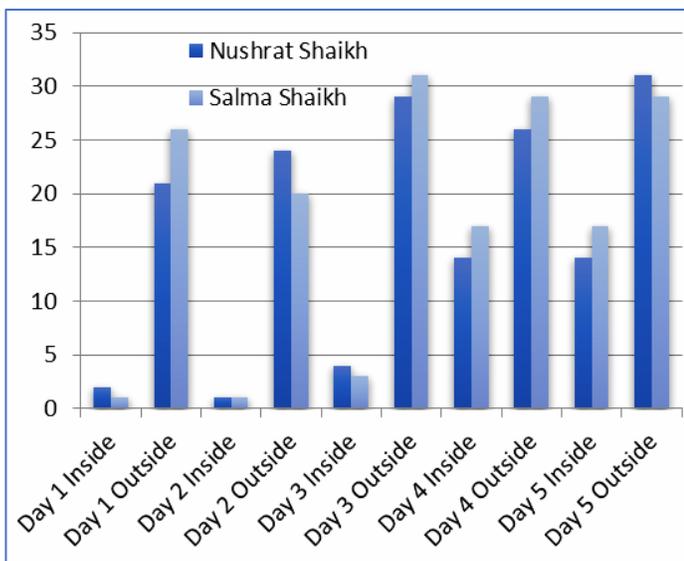


Figure 6: graphical representation of final stage

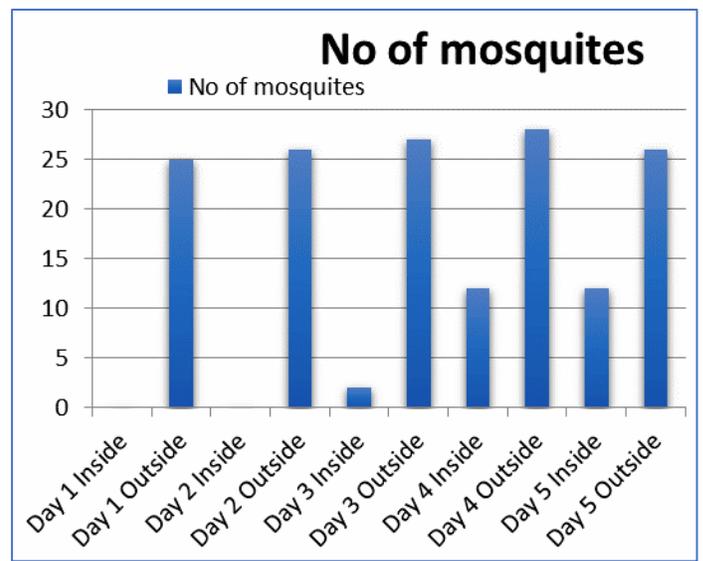


Figure 9: graphical representation of the final stage

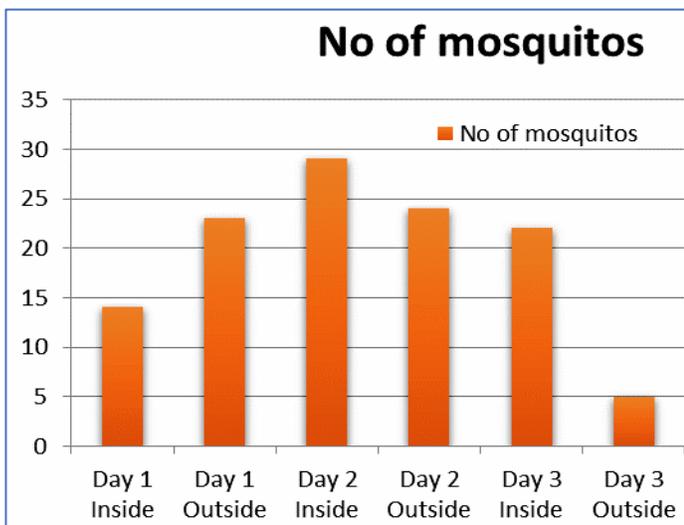


Figure 7: graphical representation of initial stage

DISCUSSION

For prevention of vector borne disease as well as the awful insects bite, insect repellents is the most dynamic tool. Nowadays synthetic mosquito repellents are most widely used, more precisely the ones containing DEET which is associated with many problems such as skin irritation, cough, respiratory diseases etc.

Natural or organic mosquito repellents can be used to overcome this issue, as they are less harmful and having no negative impact on environment. According to studies, it has been evaluated that frequent use of chemical insecticides on mosquitoes has built a resistance against these synthetic repellents. As well as it has been also reported that certain plant extracts or essential oils can also be used as a mosquito repellent.

The sprays used in this study were natural oils, which neither cause any harm to the human health nor to the environment.

The efficiency of natural oil as mosquito repellent sprays inside the house was excellent when compared with the efficiency of spray outside the house in the balcony. The efficiency of the Neem oil spray and the combination of lemon grass + neem oil as mosquito repellent inside the house was much more than compared with lemon grass oil. The lemon grass oil + neem oil spray was good at repelling mosquitoes outside the house when compared with neem oil and lemon grass oil spray. These sprays also have a refreshing smell which is accepted by the users. The only drawback of these repellents is that they don't last long i.e their protection time is lesser than the synthetic repellents. The study was conducted to prove that the natural oils are efficient in repelling the mosquito and the sprays produced by them are also affordable by the poor community due to its low cost of making. The cost of this natural mosquito repellent is less than 90% of the mosquito repellent available in the market.

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