

## Development of a mosquito-repelling paint

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### Introduction

Mosquito-borne diseases affect millions of people worldwide each year. They are the carriers of many harmful diseases such as West Nile Virus disease; Malaria, Dengue Fever, Chikungunya, Lyme disease, etc. (Aremu *et al.*, 2009). A mosquito repellent is a substance applied to skin, clothing, or other surfaces which discourages mosquitoes from landing or climbing on that surface. However, existing products used for mosquito control have varying degrees of effectiveness (Patel *et al.*, 2012). In this research, attempts were made to develop a mosquito repelling paint. In general, paints are stable mechanical dispersions of pigment, binder and solvent. Upon evaporation of the solvent, the pigment and binder form a continuous film that can be protective or decorative or both. Also some additives are normally added to paint formulation in order to tailor the paint to a specific purpose. In this research, Neem oil was used as an additive on emulsion paint for the purpose of developing a mosquito-repelling paint.

### Methodology

Neem oil was extracted from Neem seeds by mechanical pressing method. A known quantity of Neem oil was added to the desired amount of the pure paint. The mixture was stirred vigorously for 20 minutes by using a magnetic stirrer. The above procedure was repeated for four different pure paint/ Neem oil ratios of 90:10, 88:12, 85:15 and 80:20. Two paints, one light and other dark were used in the study. The samples prepared using the light colour paint with varying amounts of Neem oil were named as L10, L12, L15 and L20, respectively. The samples prepared using the dark colour paint with varying amounts of Neem oil were named as D10, D12, D15 and D20, respectively.

A box with desired dimension was prepared using cardboard in which the upper part was removed and replaced with a glass. The modified paint was applied to two vertical surfaces and pure paint which was used as the control was applied to the rest of the two vertical surfaces of the box. Then it was allowed to dry. The mosquitoes were caught by using a net and then placed them in the box already coated with paint. The above procedure was repeated for the samples prepared with both light and dark colour paints. The mosquito-repellency of the paints were calculated by counting the number of mosquitoes landed on each vertical surface over a testing period of 4 hours between 17.00 h and 21.00 h. Readings were taken at each 30 min interval, at 25- 30 °C and a relative humidity of 60 – 80% under both the presence and absence of light.

Finally, the effect of Neem oil on desired paint properties such as glossiness, contrast ratio, abrasion resistance and water resistance were determined.

### Results and Discussion

The mosquito-repellency was calculated according to the number of mosquitoes that were prevented from landing compared to the number of mosquitoes that landed on the control by using the following equation (Kazembe *et al.*, 2012).

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$$\% \text{ Repellency} = [(C-T)/C] \times 100$$

where C is the number of mosquitoes that landed on the total coated areas of the box and T is the number of mosquitoes that landed on the Neem oil modified paint coated areas of the box.

The results for mean percentage mosquito-repellency of light colour paint with varying amounts of Neem oil in the absence of light is shown in Figure 01. Results indicate that 100% repellency is shown by samples L10, L12, L15 and L20 for 8 days, 11 days, 16 days and 16 days, respectively. According to the results, mosquito-repellency remained above 80% for 30 days.

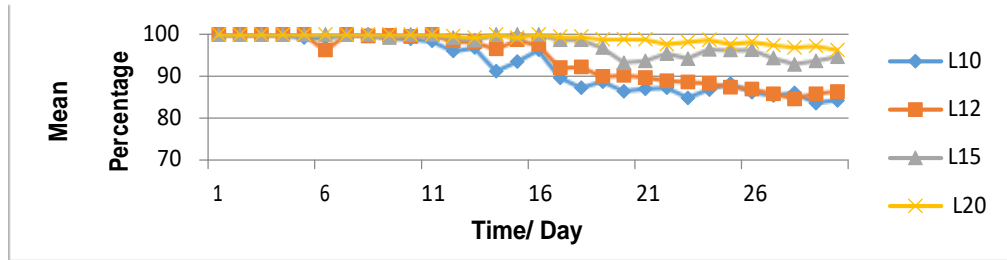


Figure 01: Mean percentage repellency of the light colour paint with varying amount of Neem oil in the absence of light

The results for mean percentage mosquito-repellency of light colour paint with varying amounts of Neem oil in the presence of light is shown in Figure 02. According to the results, 100% repellency is shown by samples L10, L12, L15 and L20 for 7 days, 11 days, 16 days and 17 days, respectively. Mosquito-repellency remained above 80% for 30 days in the presence of light as well.

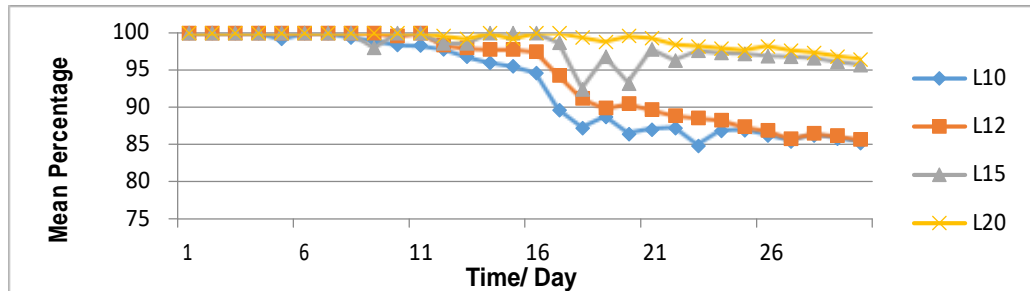


Figure 02: Mean percentage repellency of the light colour paint with varying amount of Neem oil in the presence of light

Similar results were obtained for dark colour paint with varying amounts of Neem oil in the absence as well as in the presence of light. Mosquito-repellency remained above 85% for 30 days in the absence of light and above 80% in the presence of light.

The observed results could be explained by the fact that when the mosquitoes sense the discomfort of the chemical constituent of Neem oil added paint, they left the surface. Azadirachtin, a complex tetranorterpeneoid limonoid compound from the Neem seeds, is the main component responsible for the toxic effects in mosquitoes (Aremu *et al.*, 2009). The mean percentage repellency increased with the Neem oil concentration due to the increase in active ingredients with the increase in Neem oil concentration. Mean percentage repellency decreased with time due to the evaporation of Neem oil to the atmosphere. Mean percentage mosquito-repellency is affected by several factors such as

ambient temperature, humidity, wind speed, level of activity, species of mosquitoes, amount of perspiration, density of mosquitoes' population and several other factors. Some desired paint properties of the samples L10, L12, L15 and L20 are given in Table 01.

Table 01: Effect of Neem oil on paint properties

Paint Property	Sample L10	Sample L12	Sample L15	Sample L20	Reference
Gloss D65/ 10	2.08	2.25	2.15	2.33	2.58
Contrast Ratio (%)	94.80	92.22	92.23	91.79	98.27
Abrasion resistance (Number of cycles for 1 <sup>st</sup> erosion)	25	17	6	2	6700
Water resistance (Time/ min)	17	50	16	10	95
Leveling and flow properties	Less	Good	Less	Less	Good
pH	7.40	6.82	7.23	7.02	7.88
Total solid content (wt %)	54.77	49.76	56.65	58.60	51.91
Viscosity (Cps)	5300	2500	5200	5900	3700

According to the results, paint properties such as glossiness, contrast ratio, pH and total solid content remained in acceptable range of values when compared with the control sample. However, the abrasion resistance and the water resistance have been drastically reduced. This could be due to the less compatibility of Neem oil with paint and possible evaporation of the active ingredient.

## Conclusions

In this research, attempts were taken to develop a mosquito-repelling paint using Neem oil as an additive. Results indicate that Neem oil added paint has a great repellency effect on mosquitoes. The mean percentage mosquito-repellency remained above 80 % for 30 days and increased with the Neem oil concentration. Paint properties such as glossiness, contrast ratio, viscosity, pH and total solid content are within the standard range. However water resistance and abrasion resistance have been decreased. Further research has to be carried out to maintain all the desired paint properties at acceptable levels and to maintain mosquito-repellency for a longer period of time. This could be achieved by enhancing chemical bonding to achieve better compatibility of the phases involved.

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