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# Renofluthrin: Novel pyrethroid insecticide mosquito coil for mosquito control

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**Abstract**
Mosquito coils (MC) are used to prevent mosquito exposures indoors by more than two billion people worldwide. Burning mosquito coil indoors generates smoke that can control mosquitoes. The aim of this study was to evaluate novel Pyrethroid based mosquito coil (Renofluthrin 0.025% w/w) for analysis of its physical properties, active ingredient and bioefficacy against *Aedes aegypti*, *Culex quinquefasciatus* and *Anopheles stephensi* under laboratory conditions. The Knockdown time ($KT_{50}$ and $KT_{95}$) values of each species were evaluated after exposure of 1, 6 and 11hrs time intervals in Peet Grady chamber. Subsequently, the studies were also conducted with commercial coil containing d-trans Allethrin 0.1% w/w for comparison. The findings of the present study confirm that Renofluthrin (0.025%) mosquito coil was found to be more effective as compared to commercially available mosquito coil (d-trans Allethrin 0.1% w/w).

**Keywords:** Coil、Renofluthrin, Mosquito.

## Introduction
Mosquitoes are found all over the world except in the Antarctica. Mosquitoes with anthropholic behavior prefer feeding on host blood[1]. Mosquitoes are vectors of many lives threatened diseases in humans. Diseases transmitted include Malaria, Dengue and Chickungunya (Pemba 2008). Currently control of mosquitoes mostly depends upon indoor residual spray (IRS) and long lasting insecticide treated nets (LLINS)[2]. Repellents either activate or inhibit action of olfactory receptors interfering with the host seeking behavior of mosquitoes, resulting in repellency or anti-feeding [3]. Basically Pyrethroid repellent disrupts insect behavior to inhibit odorant receptors. Various tools such as mosquito coil, liquid vaporizer, mats and ambient chambers are extensively studied and they have been promoted as formal methods for mosquito control. More ever, these are introduced as a formal means of disease control in Integrated Vector Management (IVM) strategy.
Mosquito coils were actually invented in Japan at the end of the 19$^{th}$ Century. These have been shown to repel and disrupt the host seeking activity of mosquitoes followed by knock down effect[5-8]. However, the mortality of mosquitoes caused by mosquito coils may be slow[9-12].
The present study was initiated to determine the physical properties, active ingredient content and bioefficacy of novel Pyrethroid insecticide mosquito coil Renofluthrin 0.025% w/w and d-trans Allethrin 0.1% w/w against three different species of mosquitoes.

## Materials and Methods
### Test chemical
Coils incorporated with Renofluthrin 0.025% w/w were supplied by M/S Shogan Organic Limited, Mumbai [Intellectual property India patent application 2087/MUM/2014 filed by Shogan Organic Limited on JUNE 27 manufacture use product formulation of Renofluthrin published on August 29. Issue number: 35(2014)] and commercial coil d-trans Allethrin 0.1% w/w obtained from local market.

### Mosquito culture:
Mosquitoes *viz.Aedes aegypti*, *Culex quinquefasciatus* and *Anopheles stephensi* were reared and maintained at 28±2ºC and 70-80% Relative Humidity with 12 hr light/dark cycle as per the procedure.

**Analysis of mosquito coil**

**Physical parameters**

Length, weight and burn rate of both coils were determined at each time point after 1, 6 and 11 hr exposure as per standard procedure.

**Active ingredient analysis**

Prior to initiating bioefficacy studies active ingredient analysis was performed by GC-FID method to ascertain active ingredient content in the representative coil. Renofluthrin was analyzed by GC equipped with FID by using a capillary column HP- 5, 30m X 0.250mm X 0.25um, 5% phenyl, 95% methyl polysiloxane. Benzyl butyl phthalate was used as internal standards. d-trans Allethrin was estimated by following BIS method prescribed in IS-13438(1992) for allethrin mosquito coil.

**Bioefficacy assay**

Bioefficacy study of two mosquito coil (Renofluthrin 0.025% w/w and d-trans Allethrin 0.1% w/w) was conducted in Peet Grady chamber (5.832 cubic ft). Forty to fifty female mosquitoes of each species (sucrose fed and 2-3 days old) was used for trials. Experiments were conducted at different time intervals *viz.*1,6 and 11hrs exposure of each coil separately in chamber. Observations (Knock down) were collected and kept in recovery jars containing 5% sucrose for monitoring revival rate after 24 hrs period. The experiments were conducted with five replicates of each exposure against each mosquito species. $KT_{50}$ and $KT_{90}$ values of each time interval were calculated by subjecting the data to Probit analysis.

**Results and Discussion**

**Physical Parameters**

Initial coil weight, coil weight after burn and active ingredient released in the chamber for each time intervals (1, 6 and 11 hrs) for one hour were studied and data presented in Table 1. Results indicate that there is a marginal difference between coil weight and coil loss at 3 time intervals in both these coils. However, regarding active ingredient loss per hour in chamber, 0.1% d-trans Allethrin w/w releases more (1.6099, 1.5970 and 1.5929mg/h) as compared to Renofluthrin 0.025% w/w (0.3960, 0.3894 and 0.4006mg/h) at different time intervals.

**Table 1:** Physical properties of Renofluthrin0.025%w/w and d-trans Allethrin 0.1%w/w mosquito coil

| Coil | Time Interval (h) | Initial weight (g) | Weight after one hour of burning(g) | Weight loss after 1 hour(g) | Active loss per hour (mg/h) | Length of the coil burned (mm/h) |
|---|---|---|---|---|---|---|
| Renofluthrin 0.025%w/w | 1 | 18.4112 | 16.8273 | 1.5840 | 0.3960 | 92 |
| | 6 | 10.5623 | 9.0048 | 1.5575 | 0.3894 | 90 |
| | 11 | 2.6332 | 1.0309 | 1.6023 | 0.4006 | 92 |
| d-Trans allethrin 0.1% w/w | 1 | 18.4247 | 16.8148 | 1.6019 | 1.6099 | 94 |
| | 6 | 10.5296 | 8.9326 | 1.5970 | 1.5970 | 90 |
| | 11 | 2.5801 | 0.9873 | 1.5929 | 1.5929 | 90 |

**Active ingredients analysis of coil**

The mean active ingredient of Renofluthrin coils were found to be 0.0251% w/w, whereas those of d-trans allethrin coils were 0.11% w/w. The content of active ingredient Renofluthrin in coil was 4.38 times lesser than content of d-trans allethrin coil. (Table 2)

**Table 2:** Chemical analysis of Coil

| Sample code | Replicate | Weight of Renofluthrin in WS solution | Area of IS in the WS Solution | Area of Renofluthrin in the sample solution | Weight of Sample | Area of Renofluthrin in the WS solution | Area of IS in the Sample Solution | Purity of Renofluthrin Standard | Renofluthrin % w/w |
|---|---|---|---|---|---|---|---|---|---|
| | | M1 | A1 | A4 | M2 | A2 | A3 | P | C |
| Renofluthrin Coil | Replicate (1) | 0.00283 | 89314 | 33629 | 10.005 | 71125 | 46607 | 97.98 | 0.0251 |

**Bioefficacy**

***Aedes aegypti***

**Renofluthrin coil:** The coil showed 100% Knock down effect within 30 minutes. The mean of experiment 1 and 2. $KT_{50}$ values for 1st, 6th and 11th hour exposure were 20.99, 20.49 and 20.72 minutes, respectively. The $KT_{95}$ for 1st, 6th and 11th hour exposure were 35.18, 33.45 and 34.54 minutes, respectively. (Table 3)

**Table 3:**$KT_{50}$ and $KT_{90}$ values of Renofluthrin0.025%w/w and d-trans Allethrin0.1% w/w mosquito coil against three species of mosquitoes.

| Insect | Coil | Time interval | $KT_{50}$ (mints) | Fiducial limit (mints) | $KT_{95}$ (mints) | Fiducial limit (mints) | Regression equation |
|---|---|---|---|---|---|---|---|
| *Aedes aegypti* | Renofluthrin 0.025w/w | 1 | 20.99 | 20.01-21.97 | 35.18 | 33.50-37.22 | Y=0.11+(-2.44)X |
| | | 6 | 20.49 | 19.55-21.44 | 33.45 | 31.77-35.53 | Y=0.13+(-2.60)X |
| | | 11 | 20.72 | 18.49-22.99 | 34.54 | 30.96-40.36 | Y=0.12+(-2.47)X |
| | d-Trans allethrin 0.1%w/w | 1 | 26.12 | 24.12-28.22 | 40.37 | 36.97-45.57 | Y=0.12+(-3.01)X |
| | | 6 | 24.16 | 23.18-25.14 | 38.31 | 36.57-40.44 | Y=0.12+(2.81)X |
| | | 11 | 24.77 | 22.86-26.76 | 39.47 | 36.20-44.27 | Y=0.11+(-2.77)X |
| *Culex quinquefasciatus* | Renofluthrin 0.025%w/w | 1 | 25.11 | 21.76-28.82 | 42.78 | 37.10-53.65 | Y=0.09+(-2.34)X |
| | | 6 | 25.95 | 23.17-28.85 | 43.09 | 38.56-50.46 | Y=0.10+(-2.49)X |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | 11 | 24.99 | 23.78-26.22 | 45.53 | 43.14-48.45 | Y=0.08+(-2.00)X |
| | d-Trans allethrin 0.1%w/w | 1 | 28.11 | 26.07-30.25 | 47.63 | 43.78-53.10 | Y=0.08+(-2.37)X |
| | | 6 | 27.52 | 25.34-29.82 | 47.05 | 42.98-52.95 | Y=0.08+(-2.32)X |
| | | 11 | 26.08 | 23.84-28.38 | 48.47 | 44.13-54.74 | Y=0.07+(-1.92)X |
| *Anopheles stephensi* | Renofluthrin 0.025%w/w | 1 | 17.60 | 15.68-19.45 | 30.44 | 27.55-34.84 | Y=0.13+(-2.25)X |
| | | 6 | 19.19 | 18.19-20.20 | 33.59 | 31.76-35.87 | Y=0.11+(-2.19)X |
| | | 11 | 16.97 | 13.58-20.39 | 30.58 | 25.91-41.59 | Y=0.12+(-2.05)X |
| | d-Trans allethrin 0.1%w/w | 1 | 20.68 | 19.08-22.31 | 32.58 | 30.01-36.30 | Y=0.14+(-2.86)X |
| | | 6 | 21.46 | 18.93-24.14 | 35.12 | 31.07-42.25 | Y=0.12+(-2.58)X |
| | | 11 | 23.65 | 21.13-26.48 | 37.26 | 33.02-44.95 | Y=0.12+(-2.86)X |

**D trans-Allethrin coil:** The coil showed 100% Knock down effect within 30 minutes. The mean of experiment 1 and 2. $KT_{50}$ values for 1st, 6th and 11th hour exposure were 26.12, 24.16 and 24.77 minutes, respectively. The $KT_{95}$ for 1st, 6th and 11th hour exposure were 40.37, 38.31 and 39.47 minutes, respectively.

**Culex quinquefasciatus**

Renofluthrin coil: The coil showed 100% Knock down effect within 40 minutes. The mean of experiment 1 and 2. $KT_{50}$ values for 1st, 6th and 11th hour exposure were 25.11, 25.95 and 24.99 minutes, respectively. The $KT_{95}$ for 1st, 6th and 11th hour exposure were 42.78, 43.09 and 45.53 minutes, respectively.

d trans-Allethrin coil: The coil showed 100% Knock down effect within 40 minutes. The mean of experiment 1 and 2. $KT_{50}$ values for 1st, 6th and 11th hour exposure were 28.11, 27.52 and 26.08 minutes, respectively. The $KT_{95}$ for 1st, 6th and 11th hour exposure were 47.63, 47.05 and 48.47 minutes, respectively.

**Anopheles stephensi**

Renofluthrin coil: The coil showed 100% Knock down effect within 25-30 minutes. The mean of experiment 1 and 2. $KT_{50}$ values for 1st, 6th and 11th hour exposure were 17.60, 19.19 and 16.97 minutes, respectively. The $KT_{95}$ for 1st, 6th and 11th hour exposure were 30.44, 33.59 and 30.58 minutes, respectively.

d trans-Allethrin coil: The coil showed 100% Knock down effect within 25-30 minutes. The mean of experiment 1 and 2. $KT_{50}$ values for 1st, 6th and 11th hour exposure were 20.68, 21.46 and 23.65 minutes, respectively. The $KT_{95}$ for 1st, 6th and 11th hour exposure were 32.58, 35.12 and 37.26 minutes, respectively.

## Conclusion

Significant $KT_{50}$ and $KT_{95}$ values of mosquito coil (Renofluthrin 0.025% w/w) formulations against three species of mosquitoes demonstrated in the study, indicates that in spite of less active ingredient (0.02%) as compared to D trans-Allethrin (0.1%), the Renofluthrin mosquito coil was highly active even after 11 hrs exposure. This indicated that as potent household insecticide it can be explored for protecting human population from mosquito bites. This Pyrethroid was effective even at lower concentration and not only presents lower risk to environment and non-target organism but also affordable to common man. With its proven efficacy and consumer friendly properties mosquito coil formulation. (Renofluthrin 0.025% w/w) can be incorporated to overall vector control strategies for mosquito -borne diseases.

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## References

1. Fradin MS. Mosquitoes and mosquito repellents: A Clinicians Guide, Annals of internal medicines. 1998; 128(11):931-340.
2. Steketee RW, Campbell CC. Impact of national malaria control scale up programmes in Africa: Magnitude and attribution of effects. Malar J 2010; 9:299.
3. Bohbot JD, Fu L, Le TC, Chauhan KR, Cantrell CL, Dickens JC. Multiple activities of insect repellents on odorant receptors in mosquitoes. Med vet entomol 2011; 25:436-444.
4. WHO: Guidelines for efficacy testing of household insecticide products. Mosquito coil, vaporizer mats, liquid vaporizers, ambient emanators and aerosols. (WHO ed., vol. 3.geneva: WHO/NTD/WHOPES; 2009).
5. Maclver DR. Mosquito coils. Part-II: Studies on the action of mosquito coil smoke on mosquitoes. Pyrethrum post, 1964; 07:7-14.
6. Fales JH, Mills GD Jr. Evaluation of smoke from insecticidal coils against mosquitoes.Mosquito news 1968; 28:547-553.
7. Mace EF. Biological test method for mosquito coils. Pyrethrum post, 1969; 10:41-43.
8. Teshima H. Effects of mosquito coils on feeding behavior of mosquitoes. Sumitomo Pyrethroid (SP world), 1993; 21:3-6.
9. Smith A, Chadwick PR.A reassessment of pyrethrum against Anopheles gambiae with particular reference to its action as a residual repellent. East African MedJ. 1964; 41:137-141.
10. Smith A, Obudho WO. Trials with mosquito coil against mosquito Anopheles gambiae entering a veranda trap hut. Pyrethrum post, 1967; 09:15-17.
11. Smith A, Obudho WO, Esozed S, Myamba J. Louvre-Trap hut assessment of mosquito coils, with a high pyrethrin 1/ pyrethrin II ratio, against Anopheles gambiae giles, Culex fatigans Wied. And Mansonia uniformis (Theo).East African Med J. 1973; 50:352-361.
12. Mosha FM, Ngau RJA, Myamba J.Biological efficacy of new formulation of mosquito coils and a critical review of test methods Pyrethrum post,1989; 17:476-481.