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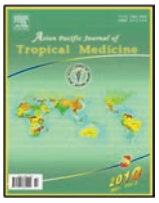

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Effect of common salt on laboratory reared immature stages of *Aedes aegypti* (L)

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ABSTRACT

Objective: To observe the effect of common salt (NaCl) on immature stages of laboratory reared *Aedes aegypti* (L). **Methods:** A laboratory colony of *Aedes aegypti* mosquitoes of Rajahmundry strain was established in the laboratory of National Institute for Communicable Disease (NICD), Rajahmundry unit at (26±2) ℃ with relative humidity of (70±10)%. 1.00%, 1.25% and 1.50% solutions of common salt (NaCl) were selected to observe the susceptibility status of immature stages of *Aedes aegypti* in laboratory. **Results:** Fifty percent larvae of *Aedes aegypti* died within 19, 31 and 48 hours when exposed to 1.50%, 1.25% and 1.00% common salt solution, respectively. Ninety percent of the larvae died within 29, 57 and 108 hours when exposed to the same salt solutions, respectively. Very high pupal mortality was observed varying from 81.8% to 40.0%. Formation of pupae was found inversely proportional in the presence of concentration of common salt in breeding water. **Conclusions:** With easy availability, less toxicity and long lasting nature, common salt may be applied in unused containers, especially in junkyards where surveillance mechanism is poor along with other conventional vector control methods in order to control breeding of *Aedes aegypti*, the vector of dengue/ dengue hemorrhagic fever and chikungunya.

1. Introduction

In India, *Aedes aegypti*(*Ae. aegypti*) (L) mosquito, are not only the notorious vectors of dengue/ dengue hemorrhagic fever (DHF) and chikugunya but also terrible pest of mankind. Bites of *Ae. aegypti* mosquitoes cause allergic skin reactions like papular urticaria especially in children[1]. They breed in clean water in numerous domestic and peridomestic containers. According to National Vector Borne Disease Control Programme (NVBDCP), Govt. of India, Delhi, in 2007, a total of 5 534 dengue/ DHF and 59535 suspected chikugunya cases were recorded in India, of which 587 (10.6%) dengue/DHF and 39 (0.06%) suspected chikugunya cases were from Andhra Pradesh (AP). As per Department of Health Government of AP, the state is affected with dengue and chikugunya fever for last five years. Therefore, Government of AP along with the Union Government took combined effort to control *Ae. aegypti* menace by the methods of source reduction (elimination of larval habitats) in urban and semi urban areas, using regular larvicides, vector surveillance, and social mobilization and adopting different personal protection methods. Lots of research works are being carried out in India to search for an alternative eco-friendly friendly effective larvicide, mainly from botanical origin[2-7]. During the present study maiden attempt was therefore made to oberve the effect of common salt (sodium chloride) on laboratory reared immature stages of *Ae. aegypti*. The sodium chloride was selected for the study because it is very cheap, easily available in market as common salt and is approachable to all categories of people in India. Moreover, common salt in low concentration is eco friendly and long lasting.

2. Materials and methods

Rajahmundry town and its adjacent semi urban areas are situated on the eastern bank of river Godavari in the East Godavari district of AP. The land surface is more or less plain with high rainfall and subsoil water. As Ravikumar *et al*[8] reported, rapid urbanization, open drainage system, abundant wells, underground drinking water reservoirs and water storing habits of residents are creating mosquitogenic

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conditions, specially breeding of *Ae. aegypti* mosquitoes.

A laboratory colony of *Ae. aegypti* mosquitoes of Rajahmundry strain was established in the laboratory of NICD, Rajahmundry unit at (26±2) ℃ with relative humidity of (70±10)%.

1.00%, 1.25% and 1.50% solutions of common salt (NaCl) were selected to observe the susceptibility status of immature stages of *Ae. aegypti* in laboratory. From our previous experience it was noted that common salt solution below the concentration of 1.00% does not have significant larvicidal action. Nowadays common salt available in market contains crystalline iodine. Before conducting the experiment, a trial was given to observe death rate of immature stages of *Ae. aegypti* in the same concentration solution with analytical reagent of sodium chloride. The trial showed nearly similar results with solution of common salt. Stock solutions were prepared by dissolving 1.00 g, 1.25 g and 1.50 g of common salt in 100 mL of filtered drinking water, respectively.

Twenty five to thirty, third or early fourth instar larvae were exposed to 250 mL of water containing 1.00%, 1.25% and 1.50% common salt separately (n=30). A similar set of larvae exposed to clean filtered drinking water was considered as control (n=30). The room temperature was maintained at (26±2) ℃. Seven to 14 replicates were done against each concentration. The susceptibility tests were conducted following WHO guidelines (1970)[9,10]. Larval and pupal mortality was observed after 12 hours. Formation of pupae and their death were also observed at each time slot. The cumulative frequencies of larvae and pupae dying in every 12-hour period were calculated separately for each salt solution. The numbers of larvae/pupae exposed were different for each salt solution. To introduce uniformity, the cumulative frequencies were expressed as percentage of the totals. These percentages denoted by percentage mortality of larvae/ pupae were plotted against time slots and presented graphically.

One-way ANOVA was done against the effect of salt solution of different concentration on *Ae. aegypti* larval and pupal mortalities as well as their mortalities in relation to different time exposure.

3. Results

Results on the effect of 1.00%, 1.25% and 1.50% common salt solutions on the immature stages of *Ae. aegypti* mosquitoes were shown in Figures 1 & 2.

Out of 240 *Ae. aegypti* larvae exposed to 1.50% salt solution 11 (4.58%) larvae transformed into pupae. Rest 229 larvae died within 36 hours. Fifty and ninty percent larvae died within 19 to 29 hours, respectively. Out of 11 pupae formed 9 (81.81%) died within 60 hours.

Out of 350 *Ae. aegypti* larvae exposed to 1.25% salt solution 31 (8.85%) larvae transformed into pupae. Rest 319 larvae died within 84 hours. Nearly 50% and 90% larvae died within 31 and 57 hours, respectively. 4.5%, 8.8% and 14.2% pupal formation was observed when larvae were exposed to 1.50%, 1.25% and 1.00% salt solutions, respectively. Pupal mortality was observed as 45.16%. Fifty and 90 percent larvae died within 48 and 108 hours, respectively when exposed to 1.00% concentration. Pupa formation and mortality were observed as 14.20% and 40.00%, respectively.

Figure 1 showed that death rate of *Ae. aegypti* larvae was directly related to the concentration of the salt solutions without any significant effect. Exposure period did not express any significant effect on larval mortality neither. It was interesting to observe that high mortality rate (90.00%) occurred when laboratory reared *Ae. aegypti* larvae were exposed to 1.50% and 1.00% concentration of common salt.

Furthermore it was also observed that formation of pupae was inversely proportional to the concentration of common salt without any significant effect. It was worthy mentioning that exposure period had significant effect on the pupal morality. Figure 2 showed very high pupal death (81.80%) when exposed to 1.50% salt solution. High pupal mortality would not be normally expected in commonly used larvicides like temophos, fenthian and bacticides like BTI etc.

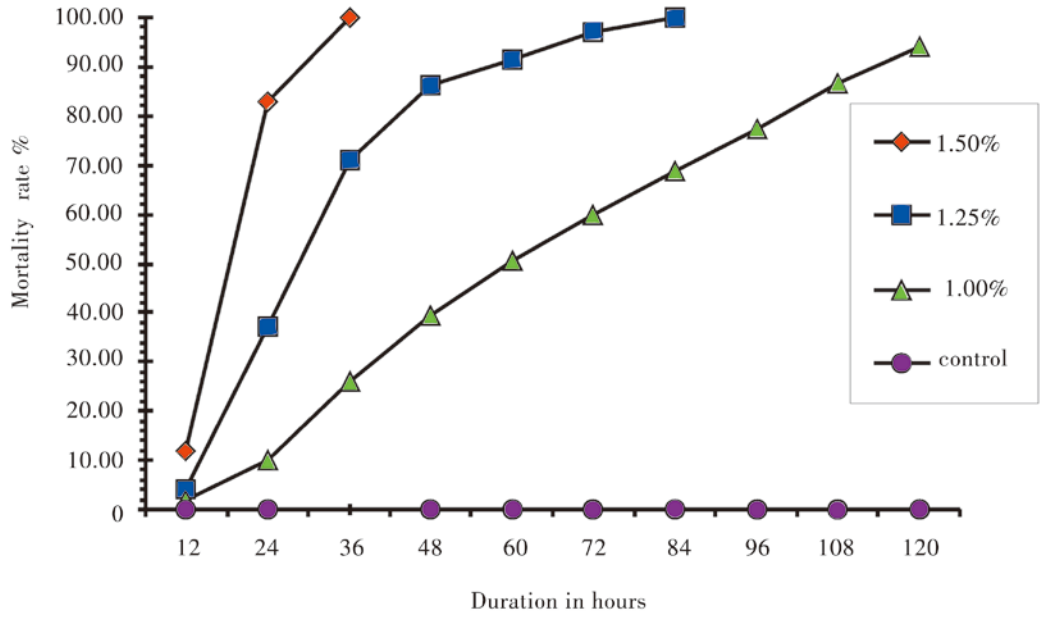

Figure 1. Effect of common salt (NaCl) on *Aedes aegypti* larvae.

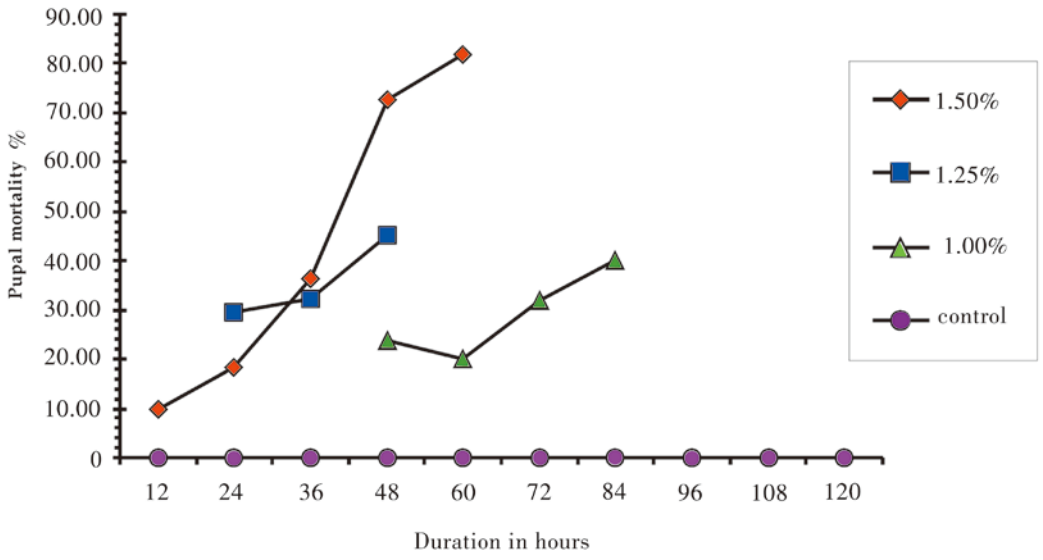

Figure 2. Effect of common salt (NaCl) on *Aedes aegypti* pupae.

4. Discussion

No recent published data is available on effect of common salt (NaCl) on immature stages of *Ae. aegypti* (L.) in India. The mode of action of sodium chloride on immature stages of *Ae. aegypti* is not known. Pappas *et al*[11] from Peru reported that less than 50% of the larvae of *Culiseta inornata* reached the pupal stage at sodium chloride concentration above 0.01m. They also observed 100% mortality of the larvae, agreeable with our present observation in case of laboratory breed, Rajahmundry station *Ae. aegypti*.

In conclusion, the findings of the present study showed that common salt concentration more than 1% in water would kill majority of larva and pupa of *Ae. aegypti* in laboratory. With long lasting, easy availability and eco-friendly nature, common salt may be included as one of the tools to prevent *Ae. aegypti* breeding in domestic and peri domestic situations. Adding common salt in suspected breeding places of *Ae. aegypti* especially in discarded tyres, containers, water holding, drams, air coolers etc. may give good results especially in the areas where surveillance and supervisory mechanisms are poor or insufficient.

Conflict of interest statement

We declare that we have no conflict of interest.

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