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SODIUM TELLURITE EXHIBITED EXCELLENT LARVICIDAL EFFICACY AGAINST *CULEX TRITAENIORHYNCHUS*

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ABSTRACT

Rift valley fever outbreaks in the Mediterranean region have been progressively increased, with recent reports of cases in Saudi Arabia through a vector *Culex tritaeniorhynchus*. Sodium tellurite is an inorganic tellurium compound with formula Na_2TeO_3. Sodium tellurite is considered to be an important compound in emerging world of corrosion resistance technology and glassware technology. The larvicidal efficacy of Sodium tellurite was performed against *Culex tritaeniorhynchus* as per WHO methods. Preliminary larvicidal efficacy of sodium tellurite was evaluated at 150 ppm concentration and percent mortality was recorded after 8 hrs, 16 hrs, and 24 hrs. The mortality was 50.83 %, 76.67 %, and 100 % respectively and no mortality was observed in control group. Quantitative larvicidal efficacy were further carried out on the basis of preliminary screening and different concentration of tellurite like 10 ppm, 25 ppm, 50 ppm, 75 ppm, 100 ppm, 125 ppm and 150 ppm were used. The LC_{50} and LC_{90} value was calculated 36.5 ppm and 96.25 ppm respectively against the *Culex tritaeniorhynchus*. No mortality was recorded in the control group in all replicated experiments. In conclusion, the Sodium tellurite is effective and may be developed as potent larvicides for vector control in future.

Keywords: *Culex tritaeniorhynchus*, Larvicidal Efficacy, and Sodium tellurite

INTRODUCTION

Mosquitoes are important vectors responsible for transmitting many dreadful human diseases such as malaria, dengue, filariasis and rift valley fever throughout the world. Millions of death were reported every year due to this vectors transmitted diseases [1, 2, 3]. Saudi Arabia is also in the list of endemic diseases like malaria and dengue and rift valley fever due to the dense population of mosquitoes in the southwest region. This region has a favorable climatic condition for permanent mosquito breeding. Saudi Arabia has witnessed tremendous efforts in social development, urbanization, and agriculture from past decades, which have affected insect fauna, particularly the mosquitoes. Thus time to time different author investigated mosquito distribution in different locality of Saudi Arab (Abdoon and Alshahrani 2003; Al Kuriji et al., 2007; Al Ghamdi et al., 2008 and Alahmad et al., 2011) which help to identify the mosquito to transmit the various diseases in that locality[4,5,6,7]. Recently Reda F Al Bakar et al., (2014) has worked on the prevalence of mosquito in the southwest region i.e. Jazan provenance, Saudi Arabia which indicated the existence of *Culex tritaeniorhynchus* [8].

Mosquito-borne diseases in Saudi Arabia are dengue, rift valley fever, malaria and filarial [9, 10, 11, 12 ,13]. *Culex tritaeniorhynchus* Giles is a common widespread species in Jazan Saudi Arabia. *Culex tritaeniorhynchus* was confirmed as a vector of Rift Valley Fever Virus (RVFV) with a biting preference for humans and sheep [14].

The continuous use of synthetic insecticides leads to the environmental and health concerns serious issues along with the widespread development of resistance by mosquitoes [15,16]. New development of synthetic insecticide always needed in the field of vector control to prevent the resistance in vectors and least harmful effects to the environment as well as health. Sodium tellurite is an inorganic tellurium compound with formula Na_2TeO_3. It is water soluble white solid powder and weak reducing agent. Sodium tellurite has growing application in the coating on iron, steel, aluminum and copper. Recently Alam et al., (2014) reported the anti-bacterial toxicity of Sodium tellurite (ST) against selected bacterial strains and results showed good antibacterial action [17]. The review of the literature indicated that sodium tellurite had not been studied prior to this study against *Culex tritaeniorhynchus.* Therefore, this compound has stimulated our interest in evaluating the larvicidal efficacy against *Culex tritaeniorhynchus*.

MATERIAL AND METHODS

Mosquito larvae and acclimatization

The third instars larvae of *Culex tritaeniorhynchus* were collected from the field of Gizan, Kingdom of Saudi Arabia. The larvae were acclimatized at room temperature 27 ± 2^0C and relative humidity of 70-80% for a day. Further larval efficacy was performed against early 4^{th} instars larvae.

Chemicals: Sodium tellurite a white powder was purchased from Sigma- Aldrich, USA through M/S Bayoni Trading Co, Dammam KSA.

Larvicidal Efficacy

Larvicidal efficacy of sodium tellurite was evaluated in two stages, preliminary and quantitative stages, against *Culex tritaeniorhynchus*. Larvicidal efficacy test of Sodium tellurite was performed according to the standard method as described earlier (WHO, 1998) under laboratory condition [18]. The preliminary larvicidal efficacy was carried out at 150ppm concentration in 500 ml capacity glass beaker containing 250 ml water by placing twenty larvae in each beaker. For the preliminary larvicidal efficacy, six replicates were used to perform the efficacy along with untreated control. All experiment was monitored after 8hr, 16hrs, and 24hrs and percent mortality was recorded. Larvae that have pupated during the test period will negate the test. If more than 10% of the control larvae pupate in the course of the experiment, the test should be discarded and repeated. If the control mortality is between 5% and 10%, the mortalities of treated groups should be corrected according to Abbott's formula. Further Quantitative larvicidal efficacy was carried out on the basis of preliminary larval mortality which showed more than 70% larval mortality after 24 hrs [19, 20]. Quantitative larvicidal efficacy of tellurite was carried out against *Culex tritaeniorhynchus* at different concentration like 10 ppm, 25 ppm, 50 ppm, 75 ppm, 100 pm, 125 ppm and 150 ppm. A mixture of dog biscuit and yeast powder into a ratio of 3: 2 were also provided as nutrients. Mortality of larvae was monitored after 24 hours. All tests were carried out in six replicates along with untreated control in the 250 ml water. The observation on percent mortality at different concentration was plotted on a log-probit paper to obtain regression line from which the lethal concentration (LC_{50} and LC_{90} values) i.e. 50 percent and 90 percent mortality was calculated by Finney methods [21].

Statistical Analysis All the experimented data were statistically analyzed for one-way

analysis of variance (ANOVA) by using mean difference students t-test. The value of p was considered as statistically significant if $p \leq 0.05$ in all instances.

RESULTS

Preliminary larvicidal efficacy of Sodium tellurite was conducted to determine the percent mortality of larvae. The experiment was monitored after 8hrs, 16hrs, and 24hrs interval and percent mortality was recorded at each interval. Results revealed that at 150pmm concentration the mortality was increased after given time periods and after 16hrs the mortality was increased significantly ($P \leq 0.05$) 76.67% while, cent percent (100%) mortality was observed after 24 hrs. The 95% Confidence Interval was 43.10 to 58.55, 68.09 to 85.23, and 97.02 to 101. 31, against 8 hrs, 16 hrs, and 24 hrs mortality observations respectively. No mortality was observed in the control group after 24hrs. The details of percent mortality along with standard deviation are given in (Table-1).

Quantitative larvicidal efficacy was carried out to determine the lethal effect of Sodium tellurite on fourth instars larvae of *Culex tritaeniorhynchus*. Results showed the dose-dependent response against the larvae of *Culex tritaeniorhynchus*. Therefore, obtained data indicated that there was positive correlation between the tellurite concentration and percent mortality. The larval mortality increased as the dose was increasing. All larvae maintained in control media survived well during the experimental period and no any morphological and behavioral changes were observed.

The mortality of larvae was monitored and it was increasing gradually from 21.67 to 100 percent against the 10 ppm to 150 ppm concentration respectively while the mortality of larvae was found nil in the control group (Table-2). The fifty percent mortality was absorbed in 36.5 ppm while the ninety percent mortality was recorded at 96.25ppm. The value of LC_{50} and LC_{90} was calculated by probit analysis and represented in the bar graph (Figure.1).

DISCUSSION

The continuous use of synthetic insecticides leads to environmental and health concerns serious issues along with the widespread development of resistance by mosquitoes [15, 16]. New development of synthetic insecticide always needed in the field of vector control to prevent the resistance in vectors and least harmful effects to the environment as well as health.

Several researchers were tried to find out the new synthetic alternative as mosquito larvicides by using different chemicals like

metal ions and some pure compound isolated from plants.

Recently M.Y. El sheikh et al., (2010) studied on lead nitrate (Pb $(NO_3)_2$) against *Culex pipiens* larvae to assess the efficacy. The LC_{50} value of lead nitrate was more 45.5 ppm as compared to sodium tellurite [22]. In the other study, Dong-Chan Lee and Young-Joon Ahn (2013) studied on synthetic compound (alpha humulene, carveol, neol, cis-myrtanol, cis-verbinol, bornyl acetate, borneol and camphor) etc against *Aedes* and *Culex* larvae. Results revealed that the obtained value of LC_{50} is 110ppm which also very high as compared to our sodium tellurite LC_{50} value [23]. Thus, the sodium tellurite showed good larvicidal efficacy against *Culex tritaeniorhynchus.*

In conclusion Sodium tellurite can play an important role to minimizing the vector burden on society by developing as potent larvicides in future. There is further need to study the safety evaluation regarding nontarget aquatic organism, mammalian and human health as a comparison to other older synthetic insecticides.

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Table-1: Preliminary Larvicidal Efficacy of Sodium tellurite against *Culex tritaeniorhynchus* at 150 ppm Concentration

% Mortality in different exposure Time (≤24hrs)					
Mean ± SD ≤8hrs		Mean ± SD ≤16hrs		Mean ± SD ≤24hrs	
Treated	Control	Treated	Control	Treated	Control
50.83 ± 7.36	Nil	*76.67 ± 8.16	Nil	100 ± 0.0	Nil

n=6 ; S.D= Standard Deviation, * significant P≤0.05,

Table-2: Quantitative Larvicidal Efficacy of Sodium Tellurite against *Culex tritaeniorhynchus*

S.No.	Concentration (ppm)	% Mortality ≤ 24 hrs (Mean ± SD)
1	150	100.00 ± 0.00
2	125	96.67 ± 4.08***
3	100	92.50 ± 8.22***
4	75	78.33 ± 6.06***
5	50	60.83 ± 7.36***
6	25	45.00 ± 7.07**
7	10	21.67 ± 6.06
8	**Control**	**0.0**

n=6 ; S.D= Standard Deviation; **significant P≤0.01; * highly significant P≤0.001**

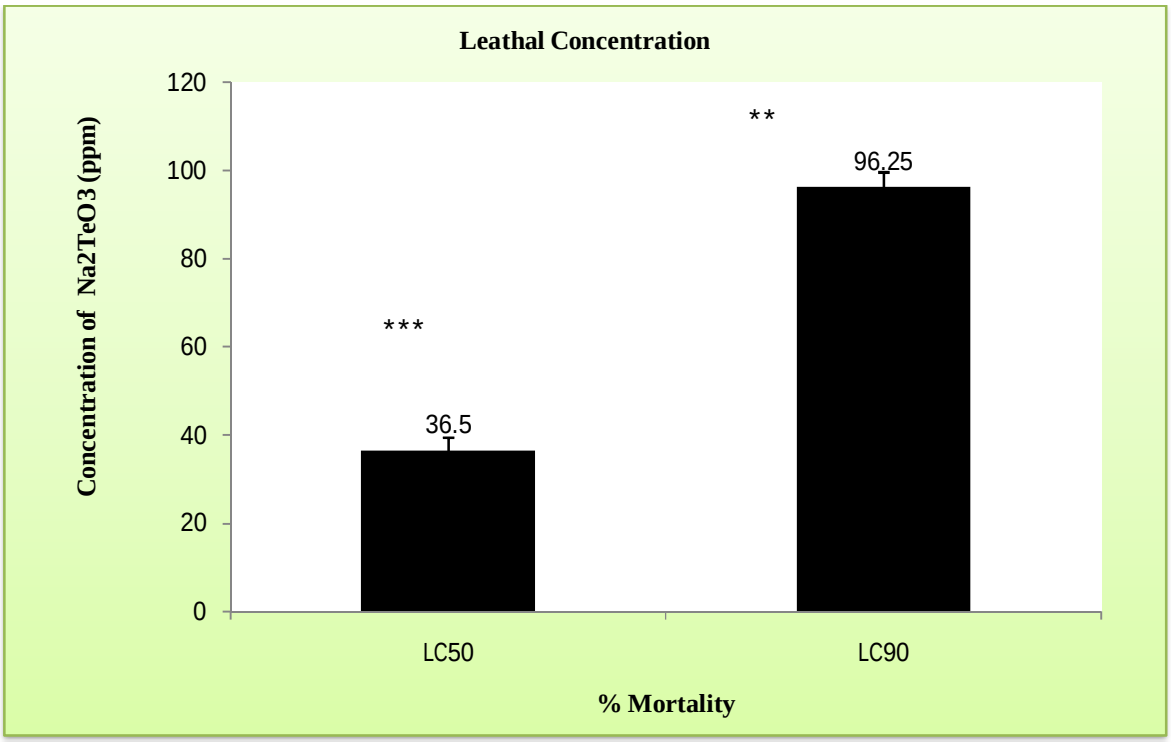

Fig.1: $LC_{50}$and LC_{90} value of Sodium tellurite against *Culex tritaeniorhynchus* larvae