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Toxicity of sodium tellurite (Na_2TeO_3) against *Aedes caspius* larvae in Gizan, Southwestern region, Kingdom of Saudi Arabia

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Abstract

The most common mosquito-borne diseases in Saudi Arabia are dengue, filaria, malaria and Rift valley fever. Rift valley fever/Dengue outbreaks in Mediterranean region have progressively increased, with recent reports of cases in Saudi Arabia. A serious out break had been seen in the southern coastal province of Jazan of Saudi Arabia. Tellurium is considered to be an important element in emerging world of corrosion resistance technology and glass ware technology. There was no literature available on mosquito larval toxicity. Thus this compound has stimulated our interest to evaluating the toxicity effect against mosquito larvae. The toxicity of Sodium tellurite was performed against *Aedes caspius* as per WHO methods. Preliminary toxicity of Sodium tellurite was evaluated at 200 ppm concentration in different time interval like 6 hrs, 12 hrs, 18 hrs and 24 hrs and percent mortality was recorded as 21.66%, 55%, 94% and 100% respectively against larvae.Therefore, further quantitative assay were carried out in different concentration of tellurite which was less than preliminary concentration such as 25 ppm, 50 ppm, 75 ppm, 100 ppm, 125 ppm, 150 ppm and 200 ppm. The LC_{50} and LC_{90} value was observed 37.5 ppm and 105 ppm respectively against the *Ae. Caspius* larvae. No mortality was observed in control group in all experiments. In conclusion, the Sodium tellurite are effective and may be developed as potent larvicides in future.

Keywords: ***Aedes caspius, larvae, Sodium tellurite, toxicity***

Introduction

Mosquitoes are the most important arthropod disease vectors, transmitting many dreadful human diseases in over 100 countries, causing mortality of nearly two million people every year (Alam *et al* 2010, WHO, 2013, Kundsen and Slooff, 1992; Klempner *et al.*, 2007). Distribution of mosquitoes (Diptera: Culicidae) in Saudi Arabia has been investigated by many workers (Abdoon and Alshahrani 2003; AlKuriji *et al.* 2007; Al Ghamdi *et al.* 2008 and Alahmed *et al.* 2011). Mattingly and Knight (1956) studied the distribution of mosquito larvae in the Arabian Peninsula and recorded 46 species and subspecies. For the past few decades, Saudi Arabia has witnessed tremendous efforts in social development and urbanization, which have affected insect fauna, particularly the mosquitoes. Expansion of agricultural projects and development of water resources, in addition to the favorable climatic conditions for mosquito survival and developments in some parts of the Eastern Region, have led to the creation of more permanent and temporary breeding sites for mosquitoes. Recently Bakar *et al.* (2014) has worked on the prevalence of mosquito in Jazanprovenance, Saudi Arabia.The most common mosquito-borne diseases in Saudi Arabia are dengue (Ayyub *et al.* 2006; Khan *et al.* 2008), filaria (Hawking 1973), malaria (Abdoon and Alsharani 2003), and Rift valley fever (Miller *et al.* 2002; Al- Hazmi *et al.* 2003; Madani *et al.* 2003). Dengue is an arthropod born viral diseases transmitted by Aedes mosquitoes. Dengue is endemic in more than 100 countries in south East Asia, the Americas, the western Pacific, Africa and the eastern Mediterranean regions and its incidence has increased 30-fold in the past 50 years (WHO, 2012). Recent estimates made in 2013 cite that 390 million people have dengue virus infections with 96 million cases annually worldwide, more than three times as per WHO's 2012 estimate. Dengue outbreaks in Mediterranean region have progressively increased, with recent reports of cases in Saudi Arabia, Pakistan, Sudan, Yemen, and Madagascar (WHO, 2009). A serious out break had been seen in 2000 (Ahmad,2000) where 76 people

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have died from an outbreak of Rift Valley fever and 408 people had contracted the disease. The outbreak began in the southern coastal province of Jizan and in the Al Quenfadah and Asir regions of Saudi Arabia. It was the first time to report Rift Valley fever outside Africa since the disease was discovered there in 1930. Jazan Province lies in the southwest of Kingdom of Saudi Arabia. It occupies an area of 13,000 km^2 which includes 455 villages. The climate is subtropical; with annual temperature 30°C Relative humidity is relatively high and usually between 50 and 70%, sometimes reaching 90% which favor the full mosquito breeding.The extensive and indiscriminate application of synthetic chemical insecticides lead to environmental and health concerns widespread development of resistance by mosquitoes (Milam *et al.*, 2000; Nauen, 2007).Tellurium is considered to be an important element in emerging world of corrosion resistance technology and Glass ware technology. Sodium tellurite ($Na_2TeO_{3)}$ has growing application in coating on iron, steel, aluminum and copper. In microbiology, sodium telluritecan be added to the growth medium to isolate bacteria with an inherent physiological resistance to its toxicity. Sodium tellurite had not been studied prior to this study against *Aedes caspius* in any country of world including kingdom of Saudi Arabia. Thus this compound has stimulated our interest in evaluating the toxicity effect against dengue vector larvae.

Material andMethods

Test mosquito and acclimatize

The larvae of *Aedes caspius* were collected from the field of Gizan, Kingdom of Saudi Arabia. The larvae were acclimatized for one weeks at room temperature 27 ± 2^0C and relative humidity of 70-80%. Then a further larval toxicity test was performed against early 4^{th} instar larvae.

Chemicals: Sodium tellurite a white powder was purchased from Sigma Aldrich, USA through M/SBayoni Trading Co, Damam KSA

Larval Toxicity

Larval toxicity test of sodium tellurite were evaluated in two phases, preliminary and quantitative phase, against *Aedes caspius*. Toxicity test of Sodium tellurite was performed according to standard method as described earlier (WHO, 1998) under laboratory condition.The preliminary larval toxicity test was carried out at 200 ppm concentration in 500 ml capacity glass beaker containing 250 ml water by placing twenty larvae in each beaker. For the preliminary larval toxicity test six replicates were used to perform the efficacy along with untreated control. All experiment was monitored after 6 hr, 12 hrs, 18 hrs and 24 hrs 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 20%, the mortalities of treated groups should be corrected according to Abbott's formula. Further Quantitative larval test was carried out on the basis of preliminary larval mortality which showed more than 70% larval mortality after 24hrs (Alam *et al.* 2011). Quantitative larval toxicity of telluritewas carried out against early fourth instar larvae of *Aedes caspius* at different concentration like 25 ppm, 50 ppm, 75 ppm,100 pm, 125 ppm,150 ppm and 200 ppm. 20 mosquitoes of larvae were placed into 500 ml capacity glass beaker containing 250 ml water. Mixture of dog biscuit and yeast powder in to 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 250ml 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) was calculated (Finney, 1971).

Statistical Analysis

All the experiment were performed with six times (n= 6) and the data were subjected to one way analysis of variance (ANOVA) by using mean difference students t-test. The acceptance level of statistical significance was $p \leq 0.05$ in all instances.

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Results and Discussion

Preliminary toxicity test of Sodium tellurite was performed to determine the percent mortality of larvae. All experiment was monitored after 6 hrs, 12 hrs, 18 hrs and 24 hrs interval and percent mortality was recorded. Results revealed that at 200

ppm concentration the mortality was increased after given time periods and after 18hrs the mortality was 94.16% while, cent percent (100%) mortality was observed before 24 hrs. No mortality was observed in control group. The details of percent mortality along with standard deviation are given in Table-1.

Table-1: Preliminary toxic exposure of Sodium tellurite against *Aedes caspicus* larvae at 200 ppm concentration

No. of Replicates	% Mortality in different exposure Time (≤24hrs)							
	Treated	Control	Treated	Control	Treated	Control	Treated	Control
	6hrs		12hrs		18hrs		24hrs	
R1	20	0	60	0	95	0	100	0
R2	15	0	50	0	100	0	100	0
R3	25	0	55	0	95	0	100	0
R4	30	0	45	0	100	0	100	0
R5	25	0	65	0	85	0	100	0
R6	15	0	55	0	90	0	100	0
Mean± SD	**21.66± 6.05 *** **	**Nil NS**	**55± 7.07 *** **	**Nil NS**	**94.16± 5.84 *** **	**Nil**	**100 ± 00 *** **	**Nil NS**

*** highly significant P≤0.001

Table-2: Quantitative toxic effects of sodium tellurite against *Aedes caspicus* larvae

Concentration (ppm)	Mortality within 24 hrs (% ± SD)
200	100 ± 0.0
150	100 ± 0.0
125	95.17± 4.26***
100	90.50 ± 6.75***
75	80.00 ± 4.47***
50	56.67 ± 8.16***
25	37.50 ± 5.24
Control	0.0

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

Quantitative Toxicity assays were performed to determine the lethal effect of Sodium tellurite on fourth instar larvae of *Aedes caspius* by exposing them to specific concentrations of the compound. All larvae maintained in control media survived well during the experimental period. As shown in Table.2. As the dose increases the percent mortality was increased against the larvae. Thus obtained data indicated that there was positive correlation between the tellurite concentration and percent mortality. The larval mortality increased gradually from 30.83% to 100% at 25 ppm to 200 ppm respectively (Table 2).The larval mortality was nil in control group. The LC_{50} and LC_{90} were also calculated from percent mortality and the value was 37.5 ppm and 105ppm respectively (Fig.1). Recently Tarek M. Y. El-Sheikh *et al* (2010) studied the Toxicological Effects of Some Heavy Metal Ions on *Culex pipiens*. Different concentrations of selected heavy metals in the form of cadmium chloride ($CdCl_2$), copper sulphate ($CuSO_4$), lead nitrate (Pb $(NO_3)_2$) and mercuric nitrate (Hg $(NO_3)_2$) were tested against immature and mature stage of *C. pipiens* to assess the toxicity, LC_{50}, total carbohydrate and lipid content. On the basis of LC_{50}, lead nitrate (Pb (45.4 ppm) showed less toxicity in comparison to other such as Cd(0.11ppm), Hg(0.44 ppm) and Cu (5.1 ppm).

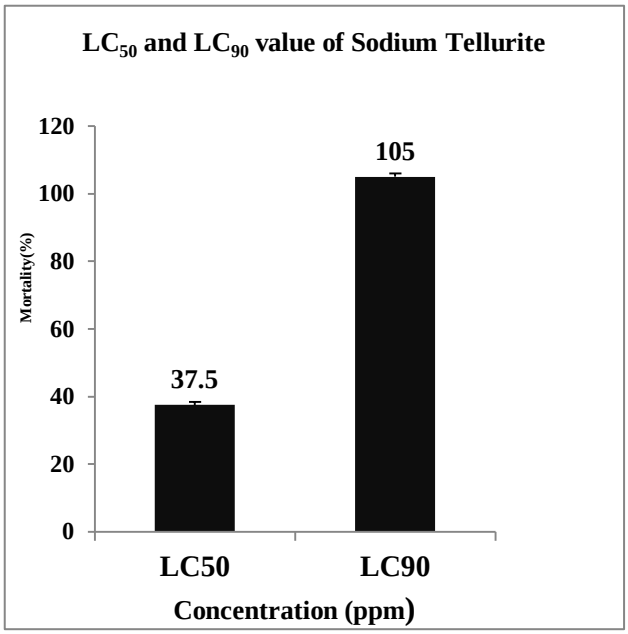

Fig1: The $LC_{50}$and LC_{90} value of Sodium tellurite against *Ae. caspius*

Scientists have also recently studied on pinus densi flora hydro distilate its 19 constituents and 28 structurally related syntheticcompounds against *Ae. Albopictus*, *Aedes agypti* and *Culex pipienspalles*. In laboratory bioassays, most of the compounds like alpha humulene, carveol, neol, cismayrtanol, cisverbinol, bornyl acetate, borneol and camphor etc. showed more than 110mg/l LC_{50} value against all vectors. This indicated that tellurium is better than that tested structurally related synthetic compounds in sense of effectiveness.Thus the sodium tellurite showed good larval toxicity against *Aedes caspius* which is alsoless than lead nitrate. In conclusion, the Sodium tellurite (Na_2TeO_3) may be developed as potent larvicides in future, if there is a not or a less side effect on non-target organism in comparison to other synthetic insecticide. These aspects deserve for further study to validate their safety to mammalian and human health, non-target aquatic organisms and the surrounding environment.

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