Toxicity impact of Mesurol pesticide on freshwater snail Viviparous bengalensis in AL-Diwaniyah river, Iraq.

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Abstract. The current study included testing the toxicity of Mesurol pesticide and its effects on the freshwater snail Viviparous bengalensis. Snails’ mortality is recorded at each 24 hours with a replacement of solution toxicity in order to avoid volatilization. Value of LC$_{50}$ is obtained and is (0.55) mg/l, during the period of 96 hours. No mortality is noticed in the control treatment for the duration of the experiment, and the toxicity of Mesurol pesticide is very toxic and deadly impact on the snails.

Key words: Viviparous bengalensis, Mesurol pesticide, toxicity.

1. Introduction:
Molluscs phylum involves diverse aquatic and terrestrial important animals across the world (SubbaRao 1993). However, the population of these animals has been reported to be less in their habitats due to habitat degradation and water pollution by chemicals such as pesticides (Gibson, 2015). Therefore, studying the toxicity of pesticides and their negative sides on freshwater bodies would help to obtain more information on the fate of these pollutants on the aquatic ecosystem. (Jagtap et al., 2011). In food chain, snails are considered good good food sources for other animals such as fish and birds because of protein enrichment in snail’s bodies (Chapman and Wang, 2001). Although the importance of snails in aquatic food webs, however, they have been combated by pesticides such as Mesurol pesticide that is considered a toxic chemical for freshwater animals (Tilak and Kumari, 2009). Then, transporting these chemical materials via food chain in snails into human communities (Khan et al., 2007). Therefore, toxicity test method plays a vital tool to quantify the risk of pollutants and pesticides on freshwater bodies including snails. Globally, several studies have been conducted on using toxicity test of pollutants on snails. For example, acute toxicity of Tributyltin Chloride (TBTCl) on Lamellidens marginalis (Jagtap et al., 2011). Their findings showed that TBTCl is highly toxic to aquatic organisms and should not be applied excessively. Toxic effects of Cythion-Malathion have been studied on two mollusks that are Lamellidens corrianus and Lamellidens marginalis (Mane and Muley, 1987). Brix et al (2011), have studied the toxically effects of copper on freshwater snail Lymnaea stagnalis and they found that the snail more sensitive to copper with concentration reaches to 31 mg/l. Locally, Farid (2005), has pointed out that Theodoxus jordani and Lymnaea auricularia are sensitive to copper with exposure period 24-48 hrs. LC$_{50}$ of both species are 13.3-16.1 mg/l.

The toxicological test represents the exposure of living organisms such as snails to toxic materials, after the preparation of a series of concentrations and their response to these concentrations during the
96-hour period. This in order to determine the half-lethal concentration that kills half the number of snails (50%) expressed in LC$_{50}$ (Abbott, 1925).

*V. bengalensis* has been chosen due to its importance in the assessment of water quality that is polluted by toxic chemicals such as Mesurol pesticide. The purpose of the current study is to find out the lethal concentration of half the number of snails, as Mesurol pesticide is used to control snails, and Mesurol pesticide has negative affects to other economic aquatic biota, such as fish and then give the best way of how to use this material properly.

2. Materials and Methods

**Sample collection**

Individuals of *V. bengalensis* were collected by hand from AL-Diwaniyah river in order to collect as much as possible of the snail. Then, snail individuals were transported to large plastic containers with water river. In the laboratory, snails were washed to remove clay and debris. After that, snails were transported to 20L aquarium and exposed to 12 hours of daylight and 12 hours of darkness. Snails were then fed by *Ceratophyllum dimerism* plant, thereafter snails were starved for 48 hrs.

**Preparation of toxicity test solution**

A stock of toxicity test solution was prepared as such 1 ml of Mesurol pesticide was taken and then diluted in 1L of distilled water (1 ml/L) solution. A set of diluted concentrations of that stock solution were made which were (0, 0.1, 0.3, 0.5, 0.7, 0.9) ml/L. 30 of *V. bengalensis* individuals were taken into containers with the prepared concentrations, while 0 concentration was considered as a control. The choice of experimental concentrations was made after conducting a series of experiments and obtain appropriate concentrations as the low concentrations did not give the results during 24-96 hours and the high concentrations cause death in all individuals within a few hours. Stop movement of snails was considered as a signal of death or failing movement of snails when subjected to a mechanical object (acupuncture needles).

The toxicity of Mesurol pesticide was obtained to calculate LC$_{50}$ over 96 hours of exposure using Probit Unit analysis method. The regression equation was used to derive the probability values calculated by equation:

$$Y = a + b \times X + e$$

Where:

- $Y$: calculated probability value.
- $b$: Regression value.
- $X$: the value of the logarithm of concentration.

3. Results and Discussion

Table (1) and figures (1-4) show the percentage of mortality of *V. bengalensis*, that exposed to different concentrations of Mesurol pesticide, and results showed a significant effect of most concentrations of the pesticide within 96 hours. It has been noticed that 0.1 ml/l concentration did not record any mortality during 24 and 48 hrs of exposure, while 0.3 ml/l has shown 10% of mortality within 72 hrs of exposure. In addition, 0.5 ml/l showed 50% of mortality in 96, whereas no mortality shown in control treatment. The average values of half lethal concentration of half experimental animals (LC$_{50}$) was 0.55 ml/l during 96 hrs of exposure to Mesurol pesticide respectively. The positive relationship between the increment of mortality rate and the concentrations from one hand and exposure time in the other hand was noticed, ($r= 0.98909, 0.88546, 0.9109, 0.93616$) for 24, 48, 72, and 96 hrs of exposure time respectively.
Table (1) Percentage of death of *V. bengalensis* during 96 hours of exposure.

| Concentration ml/L | 24  | 48  | 72  | 96  |
|--------------------|-----|-----|-----|-----|
| Control            | 0   | 0   | 0   | 0   |
| 0.1                | 0   | 0   | 10  | 16.6|
| 0.3                | 16.6| 23.3| 30  | 36.3|
| 0.5                | 36.6| 36.6| 40  | 50  |
| 0.7                | 55  | 56.6| 60  | 63.3|
| 0.9                | 65.6| 83.3| 93.3| 100 |

The calculated LC$_{50}$ for Mesurol pesticide is 0.55 ml/L.

![Mortality during 24 hrs](image1)

Figure (1) shows toxicity line between death and concentration within 24 hrs of exposure.

![Mortality during 48 hrs](image2)

Figure (2) shows toxicity line between death and concentration within 48 hrs of exposure.
4. Discussion:
Calculating LC$_{50}$ values considered very useful in determining tolerance or low risk level of pesticides or pollutants in water bodies (Prentera et al., 2004). The findings of his study are not consistent with the study of (Farid, 2005), this may be due to the difference between snails and toxic material that have been studied. Farid, (2005), has recorded the LC$_{50}$ of copper as Cu (NO$_3$)$_2$ . 3H$_2$O, 13.3 mg/l and 16.1 mg/l for Lymnae aurticularia and Theodoxus jordani respectively in 24 and 48 hrs. The variance in the recorded mortality time of snails may be because of the strategy of these snails to avoid toxic substances such as Mesurol. The strategy through adhesion to the walls of the test basin, or retreat into their shells as a precautionary means. However, Mesurol takes its toxic effect through inhibiting site action of post-synaptic nicotinic acetylcholine receptors (nAChRs), which weakens nerve signals and prevents the entry of ions into neurons. Das et al. (1994) pointed out that pesticides such as copper sulphate including Mesurol are highly toxic to freshwater biota such as snails through absorption in the internal organs to store in different tissues of snail’s body.

To conclude, this study highly recommended that using Mesurol pesticide for controlling snails should be done under recommended concentrations. This is in order to avoid killing the other economic biota.
such as plants and fish. The agricultural institutions and the other the research centres should take their responsibility to increase awareness among farmers in how to use Mesurol pesticide in combating snails as this chemical material is toxic and pollutant material to freshwater and biota.

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