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Short Communication

Effect of Arsenic on Protein of a Short Horned Grasshopper, *Oxya velox* (Fabricius, 1787)

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Abstract

Short horned grasshopper, *Oxya velox* were exposed to various doses of sodium arsenate and exhibit a significant ($p < 0.05$) dose dependent increase in protein of both gut wall and ovary. Study revealed that the amount of protein increased with the increasing doses of arsenic in comparison to control. The increase in the protein level was probably due to check the effect of toxicant and tries to recover from the stress of arsenic at various doses which indicated that arsenic may be considered as an essential trace element for this grasshopper, which was established for the first time in such type of insect who regarded as primary consumer in the terrestrial ecosystem.

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Introduction

Grasshopper is the most abundant among ground-dwelling insects, representing up to 20 to 30 per cent of arthropod biomass (Schmidt, 1986), and could be regarded as the bioindicators of heavy metal pollution as well as heavy metal concentration in the environment (Nath *et al*., 2008). Augustyniak *et al*. (2005) has been studied the joint effects of dimethoate and heavy metals on metabolic responses in *Chorthippus brunneus* from a heavy metals pollution gradient and its adaptation with the seriously polluted environments. Mukherjee *et al.* (2004)has been reported that chronic oral exposure to arsenic develops an oxidative stress on the pancreas causing diabetes mellitus. The ground water used for irrigation in most areas of India and Bangladesh is arsenic (As) contaminated and accumulation of this element in the soil eventually transfer to different trophic levels through food chain (Imamul Haq *et al*., 2006). This investigation was conducted to study the influence of As on the tissue protein of short horned grasshopper, *Oxya velox* as the effect of this heavy metal on protein of acridids was not conducted so far.

Materials and Methods

Adult acridids of interest,*Oxya velox* (Fabricius, 1787) was collected from field near Amtala, Howrah. The field was selected because this area is not considered as arsenic affected in the state of West Bengal, India. Plastic jars of 5 liters capacity containing 3.0 cm thick sand at the bottom were taken as the rearing cage. The open portion of the cages was covered with nylon net in order to maintain the air supply properly. Rearing

was carried out in laboratory conditions, with temperature ranging between 30.9°C and 36.3°C and relative humidity ranging between 60% and 98%. After copulation, the female laid eggs in the sand. After approximately 30 days of oviposition the first instars hatched out from the eggs. The first instars and their successive stages including the adult insects were also reared following the same procedure.

Conical flask of 50 ml capacity containing food plant *Oryza sativa* Lin of fifteen days old was placed in the rearing jar for providing food to the insects. To study the effects of As, fresh leaves of *Oryza sativa* was collected from the cultivated field in the college campus and dip in the dosed distilled water treated with 0.0125 $mg.l^{-1}$(d1), 0.025 $mg.l^{-1}$(d2), 0.050 $mg.l^{-1}$(d3), 0.075 $mg.l^{-1}$(d4) and 0.1 $mg.l^{-1}$(d5) sodium arsenate for twelve hours. To study the effect of As on the total protein in gut wall tissue and ovary, in the acridids of interest at different doses nymphs and adults were fed with dosed paddy seedlings and for control (C) plants grown in As free distilled water. Food was changed every 24 hours. Seven days old fully grown adult females were taken from each set of experiment and was followed for total protein (no particular protein was isolated, total amount protein which present in the extraction was estimated) estimation from gut wall tissue and ovary by the method of Lowry *et al*. (1951). The experiment was replicated five times.

Statistical analysis. Correlation coefficient (*r*), ANOVA and its significance level (*t*) were used to test for difference between different levels of treatments by using software Origin 8.5.1.

Results

The effect of arsenic salt on the total protein of gut wall and ovary of *O. velox* has been shown in Table 1. Grasshopper exposed to various doses exhibited a significant ($p < 0.05$) dose dependent increase in protein of both gut wall and ovary. Study revealed that the amount of protein increased with the increasing doses of arsenic in comparison to control in supernatant. Exposure to arsenic through food increased the amount of protein. The protein level increase to 48.35±0.49 (d5) in comparison to 28.61±0.13 $mg.g^{-1}$ (C) for gut wall. Similar trend was observed in case of ovary when treated with various doses of arsenic where volume of protein increased up to 24.93±0.46 $mg.g^{-1}$ (d5) compare to control (13.01±0.09 $mg.g^{-1}$).

Discussion

Various studies were done so far on toxicological effect of different heavy metals like Hg, Cd, Pb on various developmental stages of grasshoppers, like *Aiolopus thelassinus* (Schmidt *et al*., 1991; Devkota & Schmidt, 2000). Comparative study of various dose on proteins of gut wall and ovary of *O. velox* reveal gradual increase in amount of protein, which means this insect was able to check the poisonous effect of arsenic and able to recover the stress of arsenic at various doses. Organisms are subjected to different stresses of toxic substances in the ecosystems have their own mechanism to decontaminate various toxic substances (Migula, 2000). Usually, arsenic compounds attack the sulphur bonds and coagulate proteins (De, 2002). To overcome such toxic effect of arsenic this grasshopper tries to increase the amount of protein through its physiological processes. Evidences also revealed that in many cases arsenic have been acted as an essential trace element for the normal growth and development

Table1. Effect of arsenic on tissue protein of a grasshopper, *Oxya velox*

	Tissue	Control	Doses of Arsenic Salt ($mg.l^{-1}$)				
			0.0125	0.025	0.050	0.075	0.1
Protein	Gut wall	28.61±0.13	36.25±0.38 r= 0.98, t= 8.53* F= 354.71 y= 37.19-0.24x	29.998±0.18 r= 0.91, t=3.78* F= 38.10 y= -6.62+1.21x	33.66±0.22 r= 0.98, t= 8.53* F= 375.74 y= 22.88+0.17x	26.35±0.35 r= 0.90, t=3.66* F= 36.14 y= 33.53-0.19x	48.35±0.49 r= 0.99, t= 12.16* F= 1504.38 y= 31.22-0.05x
	ovary	13.01±0.09	16.31±0.20 r= 0.98, t= 8.53* F= 228.44 y= 9.39+0.22x	19.77±0.42 r= 0.98, t=8.53* F= 246.45 y= 10.08+0.15x	21.62±0.45 r= 0.99, t=12.16* F= 346.18 y= 14.91-0.09x	31.10±0.68 r= 0.99, t= 12.16* F= 703.49 y= 13.49-0.02x	24.93±0.46 r= 0.99, t= 12.16* F= 654.60 y= 11.57+0.06x

*significant $p < 0.05$

of experimental animals (Schwarz, 1977). Anke *et al*. (1980) has been showed a substantial increase in the mortality rate in mammal with arsenic deficit diet. Present study revealed a significant increase in the amount of protein in the grasshopper which indicated that arsenic may be considered as an essential trace element for this grasshopper, which was established for the first time in such type of insect who are regarded as primary consumer in the terrestrial ecosystem.

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