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Investigation on combined influence of selenium and zinc on sub lethal arsenic induced hexokinase variations in various brain regions of three fresh water teleosts

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Abstract
In the present investigation the author intend to study the sub lethal influence of arsenic (heavy metal) in presence of selenium and zinc on hexokinase in various brain regions *viz*. cerebrum diencephalon verebillum and medulla oblongata in *L. rohita*, *C. batrachus* and *C. punctatus* under chronic study.

Keywords: Arsenic, selenium, zinc, hexokinase and brain region

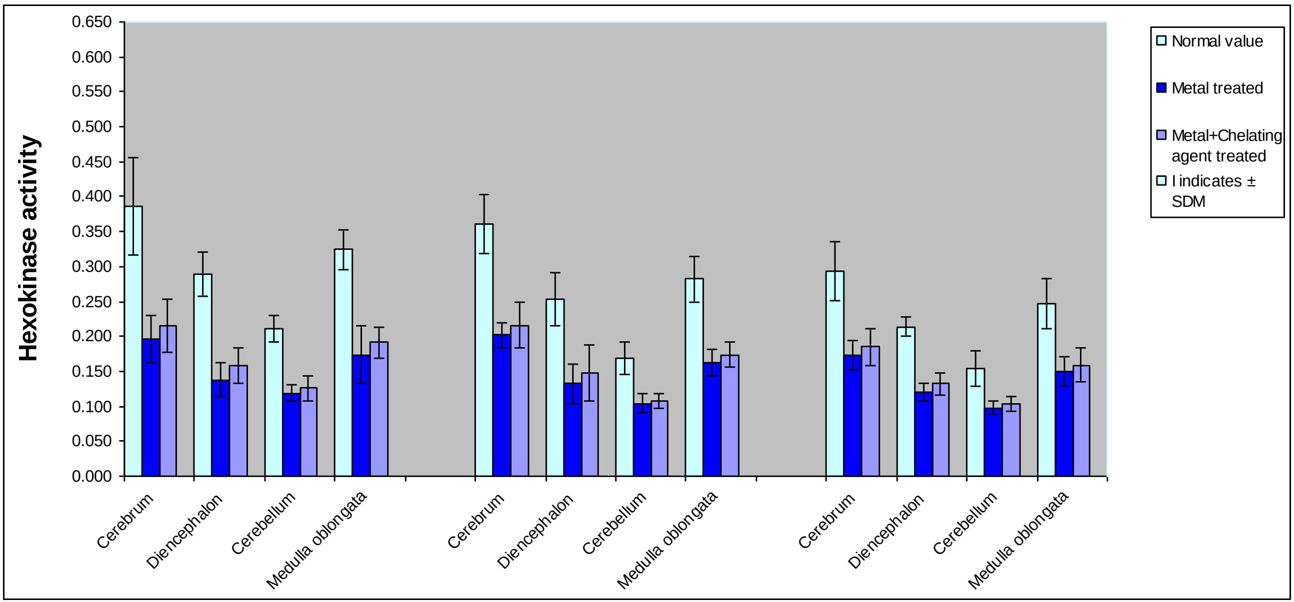
Introduction
The natural water bodies are subjected to continuous contamination and it is just the outcome of modernization. Due to their stable and persistent existence posing a serious threat to the biota and depleted biota affect the yield of economically and nutritionally important aquatic species and this in turn causing depletion in productivity and at last the yield of natural water bodies i.e. loss to consumers of the lake and revenue to the nations too. Such revenue and yield loss may indirectly affect the health of consumer (human beings) and finally making sick and infections prove situation which is unhealthy to all in the globe. [El-Shebly 2009, Gopal krishsnan & Rao 2005]
The present scenario expects more productivity and more yield to get national revenue and to led disease/dysfunction free life by maintaining a balance between industrial production and proper treatment of waste before effluent disposal and to have global abiotic /biotic standards of the water bodies. [Eshak *et al*. 2010, Fernandez & Olalla *et al*. 2000, Froese 2009, Gujawat 2005].
At present people are devising new strategies to contain contamination either by nature i.e. through some detoxification i.e. chelating agents. Hence in the present investigation the investigator would like to investigate the influence of selenium and zinc on metal caused toxicity i.e. arsenic on hexokinase in different brain regions (cerebrum, diencephalon, cerebellum and medulla oblongata) in *Labeo rohita* (Ham), *Clarias batrachus* (Linn) and *Channa punctatus* (Bloch) on a comparative approach from a tropical habitat.

Material and Methods
Determination of safety and sub lethal concentration
Safety and Sub lethal concentrations of Arsenic were determined on *Labeo rohita*, *Clarias batrachus* and *Channa punctatus* by the Probit Analysis Method (Finney, 1971). Higher concentration of arsenic were used and slowly reduced the amount of concentration to know the Lc 50/100 value for 96 hour exposure.

Enzyme Assay
The Hexokinase were assayed by the technique of Methods in Enzymology Kaplan & Colowick (1970), Crane & Sole (1953), Weiser & Quill (1972), Tsai & Kemp (1974), Racker (1946). Elliott (1955) Gracy & Tilley (1973), Plummer (1988) and Shaffi and Habibullah (1977).

Result and Discussion

The sub-lethal arsenic effect was studied on differential distribution of hexokinase in various brain regions (cerebrum, diencephalon, cerebellum and medulla oblongata) in presence of two chelators i.e. selenium and zinc and recorded the highest fall in hexokinase in diencephalon at 08 hrs, followed by cerebrum at 16 hrs, medulla oblongata at 24 hrs and cerebellum at 24 hrs in comparison to *C. batrachus* (diencephalon at 08 hrs, cerebrum at 16 hrs, medulla oblongata at 24 hrs and cerebellum at 16 hrs) and in *C. punctatus* (diencephalon at 08 hrs, cerebrum at 24 hrs, medulla oblongata at 24 hrs and cerebellum at 16 hrs) The enzyme fall i.e. hexokinase during sub-lethal exposure in presence of chelating agents under short time exposure is comparatively less than the exposure with single chelating agent in all the fish species selected and in all the brain regions identified for investigation. Among the regions of the brain it is in diencephalon maximum changes recorded and in cerebellum minimum changes were recorded. Between the fish species, *L. rohita* registered optimum changes than in *C. batrachus* and *C. punctatus.*



Graph 1: Different brain refions of (A) L. rohita (B) C. batrachus (C) C. punctatus

Table 1: Combined influence of selenium and zinc on sub-lethal arsenic induced Hexokinase variations in various brain regions in three freshwater teleosts

Name of Species	Regions of the brain	Sub-lethal (Arsenic) exposure					Sub-lethal (Arsenic) exposure with selenium and zinc				
		Control	8hrs	16hrs	24hrs	% of F/R	Control	8hrs	16hrs	24hrs	% of F/R
Labeo rohita (Ham.)	Cerebrum	0.386 ±0.069	0.326 ±0.028	0.239^{e} ±0.032	$0.196^{d,e}$ ±0.034	49	0.386 ±0.039	0.346 ±0.028	0.279^{e} ±0.032	$0.216^{d,e}$ ±0.038	44
	Diencephalon	0.289 ±0.032	0.192 ±0.016	0.166^{e} ±0.012	$0.138^{d,e}$ ±0.024	52	0.289 ±0.029	0.212 ±0.036	0.178^{e} ±0.042	0.158^{d} ±0.026	45
	Cerebellum	0.210 ±0.019	0.176 ±0.017	0.152^{e} ±0.014	$0.119^{d,e}$ ±0.012	43	0.210 ±0.019	0.196 ±0.014	0.162^{e} ±0.026	0.126^{d} ±0.018	40
	Medulla oblongata	0.324 ±0.028	0.296 ±0.022	0.252^{e} ±0.032	$0.174^{d,e}$ ±0.042	46	0.324 ±0.040	0.310 ±0.021	0.266^{e} ±0.036	$0.191^{d,e}$ ±0.022	41
Clarias batrachus (Linn.)	Cerebrum	0.361 ±0.042	0.298^{e} ±0.034	0.236^{e} ±0.042	$0.202^{e,d}$ ±0.018	44	0.361 ±0.038	0.310 ±0.022	0.248^{e} ±0.042	$0.216^{d,e}$ ±0.032	40
	Diencephalon	0.254 ±0.038	0.186 ±0.019	0.154^{e} ±0.014	0.132^{d} ±0.028	48	0.254 ±0.042	0.198 ±0.019	0.166^{e} ±0.024	$0.147^{d,e}$ ±0.040	42
	Cerebellum	0.169 ±0.024	0.146 ±0.013	0.134 ±0.010	0.104^{e} ±0.014	38	0.169 ±0.022	0.152 ±0.014	0.122 ±0.019	0.108^{e} ±0.010	36
	Medulla oblongata	0.282 ±0.032	0.256 ±0.028	0.216^{e} ±0.021	$0.163^{d,e}$ ±0.019	42	0.282 ±0.034	0.264 ±0.028	0.236 ±0.021	$0.174^{e,d}$ ±0.017	38
Channa punctatus (Bloch)	Cerebrum	0.294 ±0.042	0.256 ±0.032	0.196^{e} ±0.014	$0.173^{d,e}$ ±0.021	41	0.294 ±0.042	0.262 ±0.028	0.236^{e} ±0.042	0.185 ±0.026	37
	Diencephalon	0.214 ±0.014	0.169 ±0.012	0.144^{e} ±0.015	0.121^{e} ±0.013	43	0.214 ±0.024	0.176 ±0.027	0.152^{e} ±0.032	0.132^{d} ±0.016	38
	Cerebellum	0.154 ±0.026	0.139 ±0.012	0.122 ±0.026	0.098^{e} ±0.009	36	0.154 ±0.018	0.146 ±0.016	0.118 ±0.012	0.103^{e} ±0.010	33
	Medulla oblongata	0.246 ±0.036	0.222 ±0.024	0.198^{e} ±0.032	0.150^{e} ±0.021	39	0.246 ±0.019	0.232 ±0.034	0.206 ±0.014	0.159^{e} ±0.024	35

Values are mean ± SDM of 7 Replicates. The data was subjected to test of ANOVA and Superscripts a-e indicates that p> 0.01, 0.02, 0.03, 0.04 & 0.05.

*F-Fall /R-Rise

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