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Influence of selenium on arsenic caused variations of phosphoglucoisoisomerase in different brain regions of labeo rohita (Ham), clarias batrachus (Linn) and channa punctatus (Bloch).

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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 (chelating agent) on bio-chemical compartmentation of phosphoglucoisomerase, in various brain regions (cerebrum, diencephalon, cerebellum and medulla oblongata) in three phylogenetically and ontogenetically different fish species i.e. *Labeo rohita* (Ham), *Clarias batrachus* (Linn) and *Channa punctatus* (Bloch) under acute studies from a tropical environment.

Keywords: chelating agent, heavy metal, fish species, enzyme phosphoglucoisomerase and detoxification

Introduction

Due to enhanced human activities, heavy metal contamination has become a major environmental problem and subsequently the concentration of pollutants on rise in all the aquatic matrices. The pollutants were associated with carcinogenicity, reduced fertility, sperma-gonadotoxicity, changed bio-chemistry and altered functional status, productivity of the aquatic system, fall in yield, rise in arterial blood pressure, adverse effect on body weight, fall in secretion of directive enzymes, induced oxidative stress in viscera and blood disruption of pro-oxidant/antioxidant balance may cause tissue damage and lipid peroxidation. [Bhadauria and Flora 2003.] [8]

The investigations on metal/pollutant caused morphological / behavioural/anatomical/enzymatic/biochemical/physiologic al/development/embryology/genetics/behavioural/environm ental abiotic/ biotic factors/ productivity/ yield and to many aspects and these events are threatening the survival of Homosapiens and for the survival of the homosapiens various practical functional/ innovative approaches / designs are innovated/ designed just to protect the natural water bodies and to enhance aquatic yield and to protect the environmental and the survival of the human being with a reasonable and good health. [Banerjee *et al* 2009, Bhandari *et al* 2008, Abid *et al* 2004, Bhamre *et al* 2004] [5, 3]

In the present study the author intend to study the sub-lethal effect of arsenic in presence of chelating agent (selenium) on bio-chemical compartmentation of phosphoglucoisomerase in various brain regions (cerebrum, diencephalon, cerebellum and medulla oblongata) in three phylogenetically and ontogenetically different fish species i.e. *Labeo rohita* (Ham) *Clarias batrachus* (Linn) and *Channa punctatus* (Bloch) under acute studies from a tropical environment. [Bashandy and Alwasel 2011, Agnel *et al* 2010, Ali *et al* 2010, Archana *et al* 2010, Bolognin *et al* 2009, Borowiec *et al* 2009, Burham *et al* 2009, Ansari and Bhandari 2008, Baker *et al* 2008, Ashour *et al* 2007, Badhe *et al* 2007, Bhalla *et al* 2007, Balakrishna and Menon 2007, Bano *et al* 2007, Cao *et al* 2007, Arezzini *et al* 2004, Baldisserotto *et al* 2004, Bustamate *et al* 2002, Bergan *et al* 2001.] [7,2, 9, 10, 3, 6, 12, 4, 11]

Material and methods

Determination of safety, sub-lethal and lethal concentration:
Safety, sub-lethal concentrations of arsenic were determined on *Labeo rohita*, *Clarias batrachus* and *Channa punctatus* by the Probit Analysis Method (Finney, 1971) [26]. Higher concentration of arsenic were used and slowly reduced the amount of concentration to know the Lc 50/100 value for 96 hour exposure.

Result and discussion

The sub-lethal effect of arsenic in presence of selenium was investigated at 08 hrs, 16 hrs and 24 hrs exposure on biochemical compartmentation of phosphoglucoisomerase in various brain regions i.e. cerebrum, diencephalon, cerebellum and medulla oblongata in three fish species *viz.* *Labeo rohita*, *Clarias batrachus* and *Channa punctatus* on a comparative approach. The above said three fish species differ phylogenetically, ontogenetically, growth ratewise, nutrition intake, survival capacity and bio-chemical organization wise.

The sub lethal concentration of arsenic led to the fall of phosphoglucoisomerase to a marked level in diencephalon (at 08 hrs) accompanied by cerebrum (at 16 hrs), medulla oblongata (at 24 hrs) and cerebellum (at 24 hrs) in *L.rohita*, than in *C.batrachus* (diencephalon at 08 hrs, cerebrum and medulla oblongata at 16 hrs and cerebellum at 24 hrs) and *C.punctatus* (diencephalon at 08 hrs, cerebrum at 16 hrs, medulla oblongata at 24 hrs and cerebellum at 16 hrs).

The impact of sub-lethal arsenic was reduced in selenium presence and the fall in phosphoglucoisomerase was highest under these conditions in diencephalon (at 08 hrs) followed by cerebrum (at 08 hrs) medulla oblongata (08 hrs) and cerebellum (at 08 hrs) in *L.rohita*, in comparison to *C.batrachus* (diencephalon 08 hrs, cerebrum 16 hrs, medulla oblongata 16 hrs and cerebellum 08 hrs) and *C.punctatus* (diencephalon 08 hrs, cerebrum 16 hrs, medulla oblongata 24 hrs and cerebellum 16 hrs) (Tab and Graph-01).

The sub-lethal concentration of arsenic was investigated on various brain regions and the highest fall in phosphoglucoisomerase was recorded in diencephalon at 08 hrs accompanied by cerebrum at 24 hrs, medulla oblongata at 24 hrs and in cerebellum at 24 hrs in *L.rohita,* than in *C.batrachus* (diencephalon at 08 hrs, cerebrum at 24 hrs, medulla oblongata at 24 hrs and cerebellum at 24 hrs) and in *C.punctatus* (diencephalon at 08 hrs, cerebrum at 24 hrs, medulla oblongata at 24 hrs and cerebellum at 24 hrs).

Congenial atmosphere is a pre-condition for good physical and mental health. Stress ful/anxiety/ tension/contamination situation may spoil the balance between abiotic and biotic factors and these in turn may implant a number of disorders shortcomings and the former may affect the productivity and the affected productivity may lessen the yield of that water body directly and the revenue of the state/ country indirectly, thus contamination could be treated as contagious. At present the contamination is life threatening, as the accumulated contaminants causing histological, anatomical, hormonal, biochemical, genetic and embryological significant variations thus making body vulnerable for dysfunction/ disease prone and at last immunology too at stake. If improvised/ innovative/ practical devises are not developed to contain contamination each and every part of this nature including living organisms may start decline and may become extinct. Now it is the responsibility of all those aquatic biologist ichthyologist, aqua culturist, biochemist, physiologist and fishery scientist to innovate strategies to contain contamination and protect natural resources to enhance the yield and boost the revenue. [Eshak *et al* 2010, Chakraborthy *et al* 2009, Collins *et al* 2008, Crestani *et al* 2007, Daniel *et al* 2004, Divya *et al* 2006, El-Demerdash *et al* 2005, El-Missiry 2000.] [25, 15, 16, 17, 18, 24]

In the present investigation the author investigated the sub-lethal effect of arsenic in presence of selenium on differential distribution of phosphoglucoisomerase in various brain regions *viz* cerebrum, diencephalon, cerebellum and medulla oblongata in *L.rohita, C.batrachus* and *C.punctatus* under acute studies from a tropical habitat.

The phosphoglucoisomerase fall was highest in diencephalon than in cerebrum, medulla oblongata and cerebellum in *L.rohita,* in comparison to brain regions (cerebrum, diencephalon, cerebellum and medulla oblongata) in *C.batrachus* and *C.punctatus* at 08 to 24 hrs exposure. In presence of selenium the enzyme fall in various brain regions was comparatively less than the fall in the enzymes exposed directly to sub lethal arsenic.

The selenium might have form multiple bonds with single metal ion like arsenic through their ligands and might have form stable ring structures. In chelate the chelating agent is an electron pair donor and metal ion is electron pair acceptor. Thus the bonding between arsenic and chelating agent i.e. selenium is a coordinate covalent bond.

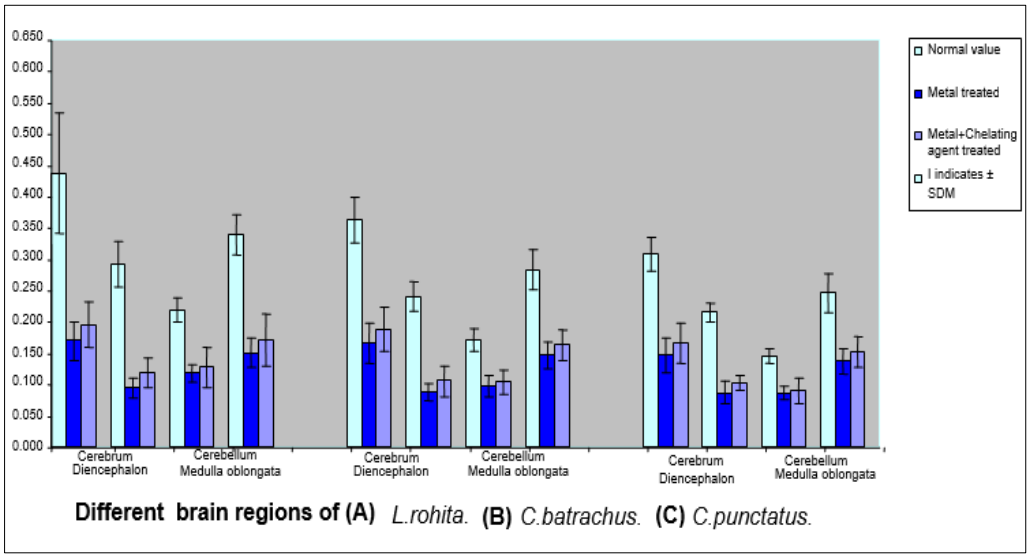
In the present investigation too such a bonding might have taken place between arsenic as toxicants, and selenium as chelators and the toxic impact of arsenic is reduced in presence of selenium and the recovery of enzyme activity during arsenic exposure in presence of selenium might be realised on the following school of thought.

In the chelating agent like selenium an electron pair donor is present. Similarly in the toxicant metals like a pair of electron acceptor might be present. The presence of electron pair donor in chelating agents and presence of electron pair acceptor in toxic metals may be one of the possible mechanism worked and the recovery or less fall of the enzymes in various brain regions of three fish species subjected to sub lethal arsenic metals might be understood on electron donor and acceptor mechanism in the present investigation.

Table 1: Influence of selenium on sub-lethal arsenic induced Phosphoglucoisomerase variations in various brain regions in three freshwater teleosts-acute studies

Name of Species	Regions of the brain	Sub lethal (Arsenic) exposure					Sub lethal (Arsenic) exposure with selenium				
		Control	8hrs	16hrs	24hrs	% of F/R	Control	8hrs	16hrs	24hrs	% of F/R
Labeo rohita (Ham.)	Cerebrum	0.438 ±0.096	0.362 ±0.082	$0.198^{c,d}$ ±0.017	$0.170^{d,e}$ ±0.032	61	0.438 ±0.098	0.322 ±0.024	$0.226^{c,d}$ ±0.032	$0.197^{d,e}$ ±0.036	55
	Diencephalon	0.293 ±0.036	0.149^{e} ±0.024	0.116^{d} ±0.012	0.096^{c} ±0.016	67	0.293 ±0.066	0.136^{b} ±0.032	0.128^{b} ±0.019	0.120^{c} ±0.024	59
	Cerebellum	0.221 ±0.019	0.184 ±0.036	0.161^{e} ±0.021	$0.119^{d,e}$ ±0.014	46	0.221 ±0.042	0.162 ±0.014	0.142^{e} ±0.024	0.128^{d} ±0.032	42
	Medulla oblongata	0.339 ±0.032	0.286 ±0.029	0.236^{e} ±0.030	$0.152^{d,e}$ ±0.024	55	0.339 ±0.038	0.252^{e} ±0.026	0.189^{d} ±0.032	$0.172^{c,d}$ ±0.042	49
Clarias batrachus Linn.)	Cerebrum	0.364 ±0.036	0.326 ±0.042	$0.198^{e,d}$ ±0.016	$0.167^{d,e}$ ±0.032	54	0.364 ±0.042	0.301 ±0.042	$0.218^{c,e}$ ±0.030	$0.189^{d,e}$ ±0.036	48
	Diencephalon	0.242 ±0.024	0.136^{b} ±0.018	0.119^{c} ±0.010	0.089^{a} ±0.014	63	0.242 ±0.019	0.176 ±0.032	0.132^{c} ±0.024	$0.106^{b,e}$ ±0.024	56
	Cerebellum	0.172 ±0.019	0.158 ±0.021	0.142^{e} ±0.012	$0.098^{d,e}$ ±0.017	43	0.172 ±0.026	0.142 ±0.014	0.121^{e} ±0.019	0.104^{d} ±0.019	39
	Medulla oblongata	0.284 ±0.032	0.242 ±0.032	0.189^{e} ±0.021	$0.147^{b,c}$ ±0.021	48	0.284 ±0.039	0.202^{e} ±0.016	0.179^{d} ±0.021	0.164^{c} ±0.024	42
Channa punctatus (Bloch)	Cerebrum	0.309 ±0.026	0.294 ±0.042	$0.176^{e,d}$ ±0.019	$0.148^{d,e}$ ±0.028	52	0.309 ±0.042	0.244 ±0.024	0.189^{e} ±0.018	0.166^{d} ±0.032	46
	Diencephalon	0.216 ±0.014	0.144 ±0.024	0.106^{e} ±0.009	$0.088^{c,d}$ ±0.018	59	0.216 ±0.018	0.128^{d} ±0.012	0.116^{e} ±0.009	0.103^{c} ±0.012	52
	Cerebellum	0.146 ±0.012	0.126 ±0.018	0.099^{e} ±0.010	0.087^{e} ±0.011	40	0.146 ±0.021	0.104 ±0.009	0.099^{e} ±0.019	0.091^{d} ±0.021	37
	Medulla oblongata	0.247 ±0.032	0.217 ±0.014	0.194 ±0.021	$0.138^{c,d}$ ±0.021	44	0.247 ±0.032	0.198^{e} ±0.022	0.169^{d} ±0.021	0.153^{c} ±0.024	38

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.



Graph 1: Phosphoglucoisomerase activity

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