IJISET - International Journal of Innovative Science, Engineering & Technology, Vol. 3 Issue 4, April 2016.
www.ijiset.com
ISSN 2348 – 7968

Zoology Role of Spirulina platensis on zinc metal caused phosphoglucoisomerase variations in brain regions of fresh water fishes.

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ABSTRACT

The *phosphoglucoisomerase* registered marked changes in diencephalons after exposure to sub-lethal levels of zinc in presence of *Spirulina platensis* followed by cerebrum, medulla oblongata & cerebellum in *Labeo rohita* than *Clarias batrachus* and *Channa punctatus.* The variations in the above said *phosphoglucoisomerase* enzyme subjected to sub-lethal zinc concentration in presence of *Spirulina platensis* less fall in various brain regions than the one exposed directly to sub- lethal concentration of zinc metal.

The sub-lethal cons. of zinc metal effect in presence of *Spirulina platensis* was investigated on *phosphoglucoisomerase* and noticed highest fall in diencephalons. exposure in comparison to cerebrum, medulla oblongata & cerebellum in *Labeo rohita***,** where as in *Clarias batrachus* and in *Channa punctatus.*

In the present investigation less fall in *phosphoglucoisomerase* enzyme in different brain regions of *Labeo rohita, Clarias batrachus* & *Channa punctatus* might be ascribed to a less degree in *Spirulina platensis* presence than direct exposure to zinc metal. *Spirulina platensis* have the detoxification ability and the present changes of enzyme levels in different brain regions of three fish species. So *Spirulina platensis* can be uses to remove heavy metals from aquatic system.

Key Words:- *Spirulina platensis,* Zinc*, Phosphoglucoisomerase,* Fresh water fishes.

Introduction:

Water is essential to life on our planet. A prerequisite of sustainable development must be to ensure uncontaminated streams, rivers, lakes and oceans. There is growing public concern about the condition of fresh water. Industrialization, privatization and globalization are the latest

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indicators for prospering of the human kind. Heavy metal pollution is a problem associated with areas of intensive industry. Heavy metals are natural components of the Earth's crust. They cannot be degraded or destroyed. To a small extent they enter our bodies via food, drinking water and air *[Masoodi et al.,2007; Kaur & Bansal, 2008]*. Heavy metal induce oxidative damage in different organs by increasing per-oxidation of membrane chemistry and altering the antioxidant system of the cells/tissues *[Lengke & Southam, 2005; Gupta & Flora, 2006 & Kumar et al. ,2007]*.

Hence the need of the man is to innovation some alternative technologies & devices to protect the nature gifted consumables and to boost the yield from natural water bodies. *[Shaffi et al., 2001, 2006 & 2007; Lima et al., 2003; Warner et al., 2003; Dadupanthi & Saini , 2005; & Masoodi et al.,2007; Kaur & Bansal, 2008]*. Heavy metal intoxication further depletes glutathione & protein bound sulfa-hydryl groups resulting into the production of reactive oxygen species like hydrogen peroxides, superoxide ions & hydroxyl radicals. Interaction of metal ions with the cell organelles cause injury to cellular components.These reactive oxygen species induce elevated visceral per-oxidation *[Kaur & Bansal, 2008 & Bert et. al. 2009]*.

In the present investigation the author made an attempt to study the influence of *Spirulina platensis* on sub - lethal concentrations of zinc metal caused marked changes in *phosphoglucoisomerase* in cerebrum, diencephalons, cerebellum and medulla oblongata in *Labeo rohita* (Ham.), *Clarias batrachus* (Linn.) and *Channa punctatus* (Bloch) under acute studies. These fishes are economically, culturally & nutritionally important for our nation.

Material & methods :

Alive, healthy, mature, disease-free & active *Labeo rohita* (Ham.), *Clarias batrachus*(Linn.) and *Channa punctatus*(Bloch.) 120-130 gm. of 18-20 cm. (standard length) were obtained from few selected local ponds to avoid ecological variation and acclimatized in the laboratory condition for a period of seven days and were subjected for various exposures and investigations.

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

Acute studies : The *Labeo rohita , Clarias batrachus* and *Channa punctatus* (120-130 gm) of 18-20 cm(standard length) were taken separately and kept in twenty groups and each group consist of forty eight fish species . No food was given to the above fish species during this period (08, 16 & 24hrs). The first set of *Labeo rohita , Clarias batrachus* and *Channa punctatus* were exposed to sub-lethal concentration of zinc and the detail were described somewhere else *(Shaffi & Kakaria2006*).

Preparation of tissue extract : The termination of the experiment,preparation of tissue extract and enzyme assays were described elsewhere [*Colowick & Kaplon,1975;Shaffi & Habbibulla,1977*].

Statistical analysis: The experiments with acute and chronic studies were repeated at least seven times separately to subject the data for analysis of variance.

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TABLE No.- 1 Influence of *Spirulina platensis* on zinc (sub-lethal) caused *phosphoglucoisomerase* variations in different brain regions of three fresh water fish species.

Regions of the Brain	Control	Duration of sub-lethal concentration exposure			% of fall/ Rise	Duration of sub-lethal concentration exposure with *Spirulina platensis*			% of fall/rise
		08 Hrs.	16 Hrs.	24 Hrs.		08 Hrs.	16 Hrs.	24 Hrs.	
		(A) *Labeo rohita (HAM)*							
Cerebrum	0.334 ±.096	0.206 c ±.026	0.189 b ±.032	0.153 a ±.019	54.19	0.210 c ±.038	0.192 ±.026	0.175 b ±.022	47.60
Diencephalon	0.272 ±.062	0.168 c ±.018	0.129 c ±.022	0.108 ±.016	60.29	0202 ±.032	0.162 c ±.018	0.122 b ±.014	55.14
Cerebellum	0.217 ±.042	0.174 ±.016	0.146 c ±.019	0.128 b ±.018	41.01	0.162 ±.026	0.148 c ±.019	0.134 ±.022	38.24
Medulla Oblongata	0.318 ±.050	0.246 c ±.024	0.179 ±.014	0.159 b ±.021	50.00	0.242 ±.041	0.205 c ±.018	0.176 ±.020	44.65
		(B) *Clarias batrachus*(LINN.)							
Cerebrum	0.315 ±.029	0.199 c ±.019	0.182 ±.026	0.160 b ±.019	49.20	0.256 ±.042	0.219 c ±.021	0.173 b ±.026	45.07
Diencephalon	0.239 ±.019	0.169 c ±.018	0.129 ±.019	0.109 ±.014	54.39	0.189 ±.032	0.148 c ±.018	0.121 ±.014	49.37
Cerebellum	0.162 ±.024	0.124 ±.014	0.106 ±.016	0.098 c ±.012	39.50	0.128 ±.024	0.112 ±.018	0.103 c ±.012	36.41
Medulla Oblongata	0.260 ±.036	0.238 ±.022	0.168 c ±.021	0.140 c ±.024	46.15	0.190 ±.019	0.164 c ±.032	0.148 b ±.019	43.06
		(C) *Channa punctatus* (BLOCH)							
Cerebrum	0.288 ±.042	0.242 ±.032	0.178 c ±.019	0.155 c ±.028	46.18	0.209 ±.026	0.184 c ±.026	0.169 b ±.021	41.31
Diencephalon	0.229 ±.019	0.198 ±.026	0.142 c ±.021	0.114 ±.011	50.00	0.184 ±.018	0.149 ±.018	0.128 c ±.014	44.10
Cerebellum	0.144 ±.018	0.132 ±.019	0.109 ±.014	0.093 ±.010	35.41	0.120 ±.014	0.109 ±.021	0.100 ±.018	30.55
Medulla Oblongata	0.240 ±.026	0.226 ±.024	0.168 ±.021	0.141 c ±.014	41.25	0.190 ±.022	0.164 ±.032	0.148 c ±.012	38.33

Values are mean ± SDM of seven replicates . The data was subjected to test of ANOVA . The super scripts (a, b & c)indicates that P >0.01, P>0.02, & P>0.05 respectively

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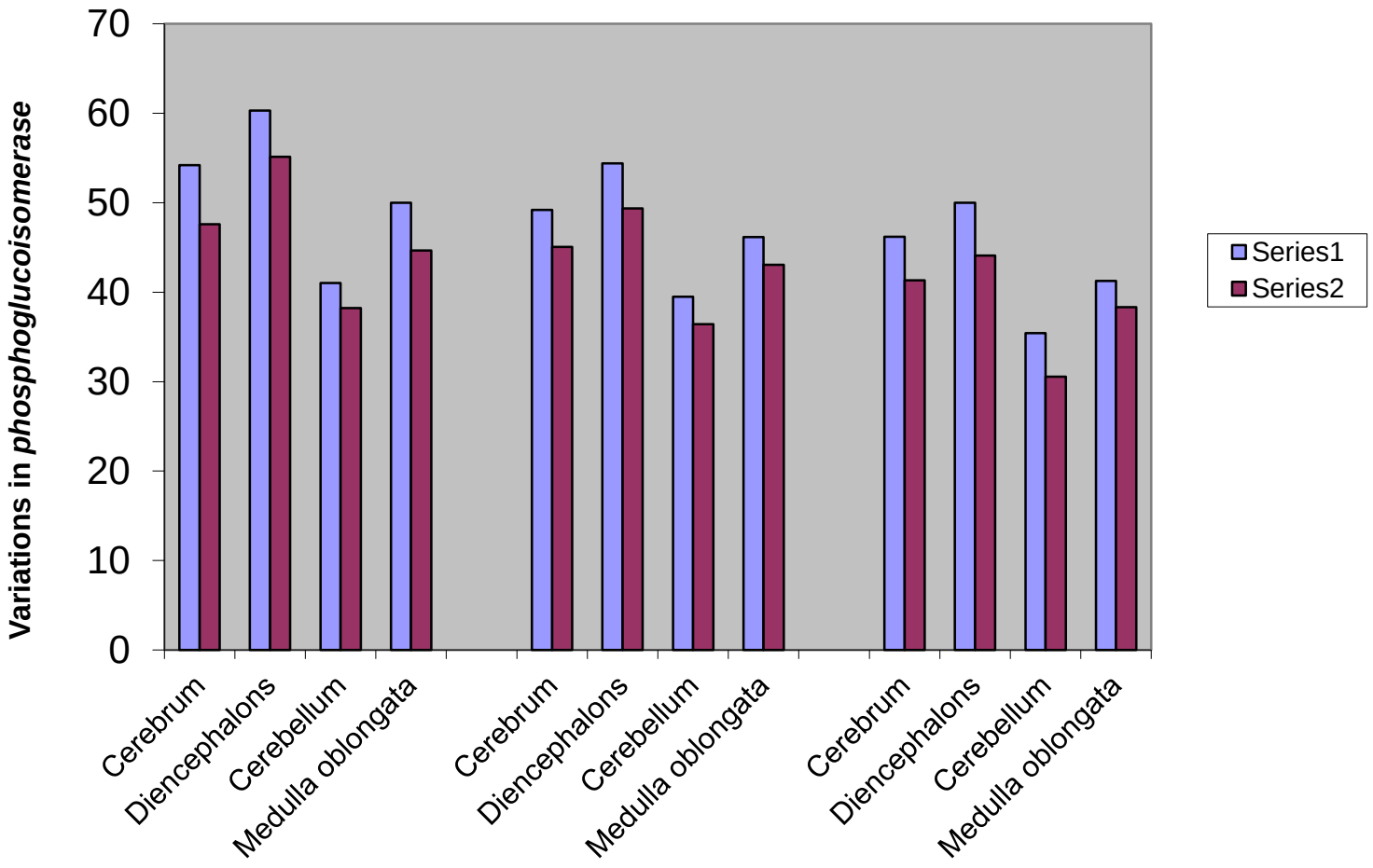

Diagram 1 :- Table No. 1:- **Different brain region of *(a) L. rohita (b) C. batruchus (c) C. punctatus.Series1*:Duration of sub-lethal concentration Zn exposure.*Series 2*:Duration of sub-lethal concentration Zn exposure with *Spirulina platensis***

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Results:

The impact of *Spirulina platensis* was investigated on sub - lethal concentrations of zinc metal toxicity on in various brain regions of *Labeo rohita*(sub-lethal concentration of Zn- 0.72 mg/ltr.), *Clarias batrachus* (sub-lethal concentration of Zn- 2.75mg/ltr.) and *Channa punctatus* (sub-lethal concentration of Zn- 2.90mg/ltr.) under acute studies.

Safety level concentrations of zinc metals was determined for *Labeo rohita* (Zn-0.10 mg/ltr.) , *Clarias batrachus* (Zn-0.14 mg/ltr.) and *Channa punctatus* (Zn- 0.18 mg/ltr.). Please see **Table-01** and chart diagrams.

The *phosphoglucoisomerase* enzyme fall in diencephalon under the influence of *Spirulina platensis* though highest but less in comparison to sub-lethal zinc toxicity induced fall than in cerebrum, medulla oblongata & cerebellum in *Labeo rohita* at 08 hrs of exposure in comparison to 16 & 24 hrs. exposure. In *Clarias batrachus* the fall in *phosphoglucoisomerase* enzyme was optimum in diencephalon at 16 hrs. exposure than at 08 & 24 hrs. exposure followed by cerebrum, medulla oblongata and cerebellum. In *Channa punctatus* the fall in *phosphoglucoisomerase* enzyme was noticed in diencephalons at 16 Hrs. of exposure than at 08 & 24 Hrs. exposure followed by cerebrum, medulla oblongata & cerebellum.

The sub-lethal cons. of zinc metal effect in presence of *Spirulina platensis* was investigated on *phosphoglucoisomerase* and noticed highest fall in diencephalons at 08 Hrs. than at 16 & 24 Hrs. exposure in comparison to cerebrum, medulla oblongata & cerebellum in *Labeo rohita***(Table-1)**, where as in *Clarias batrachus* **(Table-1)** and in *Channa punctatus* **(Table-1)**the maximum fall in *phosphoglucoisomerase* was observed in diencephalon at 16 Hrs than at 08 hrs. & 24 hrs. of exposure with reference to lethal zinc metal toxicity in presence of the microbe. The fall in *phosphoglucoisomerase* was observed in diencephalon to a large extent accompanied by cerebrum, medulla oblongata & cerebellum in *Labeo rohita* in comparison to *Clarias batrachus* and *Channa punctatus***(Table-1).**

The *phosphoglucoisomerase* registered marked changes in diencephalons after exposure to sub-lethal levels of zinc in presence of *Spirulina platensis* followed by cerebrum, medulla oblongata & cerebellum at 08 hrs than at 16 & 24 hrs. in *Labeo rohita* than *Clarias batrachus* and *Channa punctatus* **(Table-1)** .

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In all these investigations the fall in the above mentioned enzyme was optimum with zinc exposed once respectively at sub-lethal levels than in presence of *Spirulina platensis*.

Discussion and conclusion:

The present scenario even threatens the survival of the most advanced group of mammals including humans. Now time has ripened to the extent that if appropriate steps are not taken to contain the contamination, there would be nothing left as natural or pure to consume and to maintain the normal health. Hence there is a need to innovate methodologies/technologies and resources to control pollution in every walk of life *[Manjrekar et al., 2008; Krishnakumar et al.,2008; Ji-Hoon et al., 2008]*. In the present investigation too a new strategy was adapted to detoxify the metal caused toxicity on brain enzyme compartmentation in *Labeo rohita* (Ham.), *Clarias batrachus* (Linn.) and *Channa punctatus* (Bloch).

Under detoxication studies the author investigated the impact of *Spirulina platensis* on sub-lethal zinc toxicity on *phosphoglucoisomerase* variations in various brain regions of brain i.e. cerebrum, diencephalon, cerebellum and medulla oblongata in three important inland teleost viz *Labeo rohita, Clarias batrachus & Channa punctatus under* short term exposure studies.

The following finding may help to understand the microbe-metal interaction and sub sequent detoxification of the metal to a less extent in a better way*[Lu et al. ,2006; Shaffi, 2007]*. The sub-cellular regions of Cyanobacteria and *Anabaena cylindrica* could trap the lead through its phosphate and precipitates in the form of lead phosphate on the cell wall inside the cell *[Bhandari&Ansari, 2008;Bert et. al., 2009]*. Similar kind of mechanism might have taken place in the present findings i.e. less fall of enzymes in which the cellular components of *Spirulina platensis* might have precipitated the metal into compound with the help of its cellular components and the present findings i.e. less fall of enzymes in presence of a *Spirulina platensis* than the enzyme fall when directly exposed to zinc sub-lethal levels should understand on similar lines.

Such bodies not only function in polyphosphate storage and further functions as a detoxification process such a mechanism is not rule out even in the present investigation and the

ISSN 2348 – 7968

fall of *phosphoglucoisomerase* enzyme with the metal exposure directly on one side and metal exposure in presence of *Spirulina* in *Labeo rohita*, *Clarias batrachus & Channa punctatus* on both side educates that the presence of the aquatic autotroph significantly checked the fall off the enzymes in different brain regions of the above said fish species is quite innovative and need further investigation on a large scale for the application in the aquatic system and to check the menace of pollution *[Upasani & Balaraman,2003; Sharma & Sharma, 2005; Ansari & Bhandari ,2008 & Bert et. al. 2009]*.

This investigation further helps that aquatic autotrophs as like *Spirulina platensis* can be used to remove heavy metals from aquatic system.. Such events might have taken place even in the present investigation and the less fall in *phosphoglucoisomerase* enzyme in different brain regions of *Labeo rohita*, *Clarias batrachus* & *Channa punctatus* might be ascribed to a less degree in microbe presence than direct exposure to heavy metals.

ACKNOWLEDGEMENTS:- Author thankful to Prof. S.A.Shaffi Ex-Dean Of Regional Education of Institute (NCERT) Bhopal-13and Dr.V.K.Kakaria Asso.Prof. Of Regional Education of Institute (NCERT) Bhopal-13 for supervision of this work and encouragements and also Principal and Staff of Regional Education of Institute (NCERT) Bhopal-13 for providing necessary laboratory facility.

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