Impact of pesticides on biochemical analytes in Indian major carps from lakes of Ajmer.

Authors Name: - Dr. Sudha summarwar[1], Prof. (Dr.) K.P. Yadav[2]

UGC-PDF, Research Associate[1], Vice Chancellor[2]

School of Basic & Applied Science, Sangam University, Bhilwara.

Abstract

To appraise the impact of pesticides on antioxidant status and associated analytes in Indian major carps from lakes of Rajasthan, experimental material incorporated Indian major carps i.e. Rohu (*Labeo rohita*) and Catla (*Catla catla*) collected from two reservoirs (lakes) of Ajmer city, Rajasthan namely Ana Sagar lake, Ajmer, Rajasthan and Foy Sagar lake, Ajmer, Rajasthan. Effect of pollutants was evident on biochemical analytes. A significant difference ($p \leq 0.05$) was observed among the mean values of LDH, AST and ALT from each site. Fish collected from Ana Sagar site 4 revealed significantly ($p \leq 0.05$) higher values of plasma LDH, AST and ALT as compared to rest of other sites. This showed that maximum metabolic alteration was developed in the fish collected from Ana Sagar site 4. A relation of plasma enzyme activities was found with the water pH also. It can be concluded that impact of pesticides on antioxidant status and associated analytes in Indian major carps was there. Ana Sagar and Foy Sagar lakes of Ajmer, Rajasthan were having pollutants in water.

Key words: - Biochemical markers, Plasma enzyme, Biomonitoring.

Introduction

Biochemical markers are measurable responses to the exposure of an organism to xenobiotics. They usually respond to the mechanism of toxic activity. Biochemical markers detect the type of toxicity; in some of them, the magnitude of their response correlates with their level of pollution. The use of battery of biomarkers is more advantageous than the use of a single biomarker and offers an effective early warning system in biomonitoring of aquatic environment. The biochemical markers can detect early responses and pre pathological alterations before other disturbances as disease, mortality or population changes occur.

Ramesh *et al.* (2015) designed a study to compare the responses in freshwater fish exposed to a synthetic pyrethroid. Serum aspartate aminotransferase activities increased in response to exposure. Blahova *et al.* (2014) evaluated biochemical parameters after exposure to herbicide in common carps. Most experimental fish revealed significant changes in AST.Changes in the environment can bring variations in liver enzyme activity. Kumar *et al.* (2016) explored effect of endosulfan on fish and observed increased AST. Scientists have observed raised AST activities in fish following chlorpyrifos treatment Shoaib *et al. (2016*). Fishes are veritable tools for assessing the effect of pollution in aquatic environments because of their mobile nature Van der Oost *et al*. (2003) and some physiological responses from the kidney, gills, liver and heart serve as biomarkers that indicate changes in biological response (ranging from molecular, cellular and physiological to behavioral changes), caused by exposure or toxic effect of environmental chemicals Sribanjam *et al.* (2018).

The present paper is on the general use of biochemical measurements that can be used as biomarkers as diagnostic and prognostic tools for fresh water monitoring taking the fish Indian major carps as a bioindicator species.

Material & Method

1. **Study areas**

To appraise the impact of pesticides on antioxidant status and associated analytes in Indian major carps from lakes of Rajasthan, two types of fish were collected from lakes of Rajasthan. For this purpose fish type included *Labeo rohita* and *Catla catla*. The collection sites included two lakes situated in the Ajmer city of Rajasthan. These lakes were Ana Sagar and Foy Sagar lakes. Fish were collected from different areas of lakes namely Ana Sagar site 1, Ana Sagar site 2, Ana Sagar site 3, Ana Sagar site 4, Ana Sagar site 5 and Foy Sagar.

2. **Biochemical analytes**

It included following analytes:

i. Plasma lactate dehydrogenase
ii. Plasma aspartate aminotransferase
iii. Plasma alanine aminotransferase

1. Plasma lactate dehydrogenase

It was determined by colorimetric method of King as described by Varley (1988). Lactate dehydrogenase is a zinc metalloenzyme. This enzyme has a wider specificity than most oxidoreductases and catalyses the reversible oxidation of other L-α-hydroxy monocarboxylic acids besides lactate with which however, it shows greatest activity. The method is base upon the formation of pyruvate-dinitrophenylhydrazone. The colour intensity is measured with the help of a spectrophotometer.

2. Plasma aspartate aminotransferase (AST)

It was determined by spectrophoto-metric method as described by King (1965). Transaminases are enzymes which mediate the reactions in which an amino-group is transferred from an amino-acid to an a-oxo acid without the intermediate formation of ammonia. Aspartate transaminase is involved in the enzyme system forming urea. The activity of the enzyme is measured by the increase of oxaloacetate with time as the reaction proceeds from right to left. After a fixed time the oxaloacetate formed is determined spectrophotometrically by treating the 2, 4 dinitrophenylhydrazine with alkali. Aniline citrate is used to decarboxylate the oxaloacetate formed enzymatic ally.

3. Plasma alanine aminotransferase (ALT)

It was determined by Spectrophotometric method as described by King (1965). Transaminases are enzymes which mediate in reactions in which an amino-group is transferred from an amino-acid to an α-oxo acid without the intermediate formation of ammonia.

The activity of enzyme is measured by the increase of pyruvate with time. After a fixed time the pyruvate formed from L-alnine and α-oxoglutaric acid according to equation is determined colorimetrically by treating the 2, 4 dinitrophenylhydrazine with alkali.

Result & Discussion

1. Plasma lactate dehydrogenase (LDH)

Mean± SEM values of plasma lactate dehydrogenase (LDH) of male and female fish i.e. *Labeo rohita* (Rohu, *Lr)* and *Catla catla* (Catla, *Cc*) collected from different areas of Ana Sagar lake (site 1, site 2, site 3, site 4 and site 5) and Foy Sagar lake . In each gender, fish were further classified as low-weight (LW) and high weight (HW). The data are based on 20 observations for weight category as mentioned in the section of materials and methods.

A significant difference ($p \leq 0.05$) was observed among the mean values of LDH from each site. Fish collected from Ana Sagar site 4 revealed significantly ($p \leq 0.05$) higher values of plasma LDH as compared to rest of other sites. This showed that maximum metabolic alteration was developed in the fish collected from Ana Sagar site 4. A relation of plasma LDH activity was found with the water pH also. Extremely higher or lower pH affected metabolic status of fish of both genders as LDH is an important enzyme of metabolic reactions.

At each collection site, *Catla catla* fish revealed lower plasma LDH activities. This showed that LR fish developed more metabolic turn over. In both the category of fish, females showed higher activities of plasma LDH than males. This showed that females of both the type of fish developed greater metabolic turnover. Further it was noticed that low-weight fish developed greater degree of metabolic changes than high weight fish in each category. Plasma LDH was significantly ($p \leq 0.05$) higher in low-weight fish than high weight fish.

Plasma LDH activity was found to be associated with the pH of water samples from where the fish were collected. Variations in the pH of water samples indicated pollution in the water. It showed that pollution of the water changed the metabolic status of fish of both the types.

The mean values of plasma LDH in various fish obtained from *Ana Sagar* site 1 were considered as control values. On the basis of available control values it was concluded that the mean values of plasma LDH in both the types of fish showed metabolic alterations.

2. Plasma aspartate aminotransferase (AST)

Mean± SEM values of plasma aspartate aminotransferase (AST) of male and female fish i.e. *Labeo rohita* (Rohu, *Lr)* and *Catla catla* (Catla, *Cc)* collected from different areas of Ana Sagar lake (site 1, site 2, site 3, site 4 and site 5) and Foy Sagar lake . In each gender, fish were further classified as low-weight (LW) and high weight (HW). The data are based on 20 observations for weight category as mentioned in the section of materials and methods.

A significant difference ($p \leq 0.05$) was observed among the mean values of AST from each site. Fish collected from Ana Sagar site 4 revealed significantly ($p \leq 0.05$) higher values of plasma AST as compared to rest of other sites. This showed that maximum metabolic alteration was developed in the fish collected from Ana Sagar site 4. A relation of plasma AST activity was found with the water pH also. Extremely higher or lower pH affected metabolic status of fish of both genders as AST is an important enzyme of metabolic reactions.

At each collection site, *Catla catla* fish revealed higher plasma AST activities. In both the category of fish, females showed higher activities of plasma AST than males. This showed that females of both the type of fish developed greater metabolic turnover. Further it was noticed that low-weight fish developed greater degree of metabolic changes than high weight fish in each category. Plasma AST was significantly ($p \leq 0.05$) higher in low-weight fish than high weight fish.

Plasma AST activity was found to be associated with the pH of water samples from where the fish were collected. Variations in the pH of water samples indicated pollution in the water. It showed that pollution of the water changed the metabolic status of fish of both the types.

The mean values of plasma AST in various fish obtained from Ana Sagar site 1 were considered as control values. On the basis of available control values it was concluded that the mean values of plasma AST in both the types of fish showed metabolic alterations.

3. Plasma alanine aminotransferase

Mean± SEM values of plasma alanine aminotransferase (ALT) of male and female fish i.e. *Labeo rohita* (Rohu, *Lr)* and *Catla catla* (Catla, *Cc*) collected from different areas of Ana Sagar lake (site 1, site 2, site 3, site 4 and site 5) and Foy Sagar lake . In each gender, fish were further classified as low-weight (LW) and high weight (HW). The data are based on 20 observations for weight category as mentioned in the section of materials and methods.

A significant difference ($p \leq 0.05$) was observed among the mean values of ALT from each site. Fish collected from Ana Sagar site 4 revealed significantly ($p \leq 0.05$) higher values of plasma ALT as compared to rest of other sites. This showed that maximum metabolic alteration was developed in the fish collected from Ana Sagar site 4. A relation of plasma ALT activity was found with the water pH also. Extremely higher or

lower pH affected metabolic status of fish of both genders as ALT is an important enzyme of metabolic reactions.

At each collection site, *Catla catla* fish revealed higher plasma ALT activities. In both the category of fish, females showed higher activities of plasma ALT than males. This showed that females of both the type of fish developed greater metabolic turnover. Further it was noticed that low-weight fish developed greater degree of metabolic changes than high weight fish in each category. Plasma ALT was significantly ($p \leq 0.05$) higher in low-weight fish than high weight fish.

Plasma ALT activity was found to be associated with the pH of water samples from where the fish were collected. Variations in the pH of water samples indicated pollution in the water. It showed that pollution of the water changed the metabolic status of fish of both the types.

The mean values of plasma ALT in various fish obtained from Ana Sagar site 1 were considered as control values. On the basis of available control values it was concluded that the mean values of plasma ALT in both the types of fish showed metabolic alterations.

The above discussion revealed that pesticides present in the water had made sufficient impact on fish population and brought about alterations in the plasma enzyme activities of blood. Blood is an important tool to peep into the health status of fish. Values of biochemical parameters generated in the present investigation will assist in the future research in this direction. The upshot of the study will help the policy makers to design the programmers in a manner so that fish health can be improved. This will enhance the wellbeing of the ecosystem.

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Table 1: Mean values of plasma lactate dehydrogenase, aspartate amino - transferase and alanine aminotransferase of fishes collected from different areas of Ana Sagar and Foy Sagar lakes.

Name of area	Type of fish			Mean ± SEM (UL^{-1})		
				LDH	AST	ALT
Ana Sagar Site 1	*Lr* Overall value (80)			76.10 [b] ± 0.04	7.76 [b] ± 0.04	2.09[b] ± 0.04
	Lr (80)	M (40)	LW (20)	76.00[c] ± 0.001	7.75[c] ± 0.001	2.08[c] ± 0.001
			HW (20)	75.70[d] ± 0.001	7.72[d] ± 0.002	2.05[d] ± 0.001
		F (40)	LW (20)	76.50 [c] ± 0.001	7.80 [c] ± 0.002	2.13 [c] ± 0.001
			HW (20)	76.20 [d] ± 0.001	7.77 [d] ± 0.001	2.10 [d] ± 0.001
	Cc Overall value (80)			75.60 [b] ± 0.04	8.81 [b] ± 0.04	2.14 [b] ± 0.04
	Cc (80)	M (40)	LW (20)	75.50 [c] ± 0.001	8.80 [c] ± 0.001	2.13 [c] ± 0.001
			HW (20)	75.20[d] ±	8.77[d] ±	2.10[d] ±

				0.001	0.001	0.001
		F (40)	LW (20)	76.00 [c] ± 0.001	8.85 [c] ± 0.001	2.18 [c] ± 0.001
			HW (20)	75.70 [d] ± 0.001	8.82 [d] ± 0.001	2.15 [d] ± 0.001
Ana Sagar Site 2	*Lr* Overall value (80)			89.10 [b] ± 0.04	10.06 [b] ± 0.01	3.19 [b] ± 0.01
	Lr (80)	M (40)	LW (20)	89.00 [c] ± 0.001	10.05 [c] ± 0.001	3.18 [c] ± 0.001
			HW (20)	88.70[d] ± 0.001	10.02[d] ± 0.002	3.15[d] ± 0.001
		F (40)	LW (20)	89.50 [c] ± 0.001	10.10 [c] ± 0.001	3.23 [c] ± 0.001
			HW (20)	89.20 [d] ± 0.001	10.07 [d] ± 0.0014	3.20 [d] ± 0.0011
	Cc Overall value (80)			88.60 [b] ± 0.01	11.11 [b] ± 0.05	3.24 [b] ± 0.007
	Cc (80)	M (40)	LW (20)	88.50 [c] ± 0.001	11.10 [c] ± 0.001	3.23 [c] ± 0.001
			HW (20)	88.20[d] ± 0.001	11.07[d] ± 0.001	3.20[d] ± 0.001
		F (40)	LW (20)	89.00 [c] ± 0.001	11.15 [c] ± 0.001	3.28 [c] ± 0.001
			HW	88.70 [d]	11.12 [d]	3.25 [d]

			(20)	± 0.001	± 0.001	± 0.001
Ana Sagar Site 3	*Lr* Overall value (80)			92.10 [b] ± 0.03	12.36 [b] ± 0.006	3.69 [b] ± 0.006
	Lr (80)	M (40)	LW (20)	92.00 [c] ± 0.001	12.35 [c] ± 0.001	3.68 [c] ± 0.001
			HW (20)	91.70[d] ± 0.001	12.32[d] ± 0.001	3.65[d] ± 0.001
		F (40)	LW (20)	92.50 [c] ± 0.001	12.40 [c] ± 0.001	3.73 [c] ± 0.001
			HW (20)	92.20 [d] ± 0.001	12.37 [d] ± 0.001	3.70 [d] ± 0.001
	Cc Overall value (80)			91.60 [b] ± 0.04	13.41 [b] ± 0.005	3.74 [b] ± 0.005
	Cc (80)	M (40)	LW (20)	91.50 [c] ± 0.001	13.40 [c] ± 0.11	3.73 [c] ± 0.12
			HW (20)	91.20[d] ± 0.001	13.37[d] ± 0.12	3.70[d] ± 0.12
		F (40)	LW (20)	91.00 [c] ± 0.001	13.35 [c] ± 0.12	3.68 [c] ± 0.13
			HW (20)	91.70 [d] ± 0.001	13.42 [d] ± 0.001	3.75 [d] ± 0.001
Ana Sagar	*Lr* Overall value (80)			104.20 [b] ±	14.57 [b] ±	4.90 [b] ±

Site 4				0.04	0.004	0.004
	Lr (80)	M (40)	LW (20)	104.10 [c] ± 0.001	14.56 [c] ± 0.001	4.89 [c] ± 0.001
			HW (20)	103.80[d] ± 0.001	14.53[d] ± 0.001	4.86[d] ± 0.001
		F (40)	LW (20)	104.60 [c] ± 0.001	14.61 [c] ± 0.001	4.94 [c] ± 0.001
			HW (20)	104.30[d] ± 0.001	14.58[d] ± 0.001	4.91 [d] ± 0.001
	Cc Overall value (80)			103.70 [b] ± 0.04	15.62 [b] ± 0.008	4.95 [b] ± 0.008
	Cc (80)	M (40)	LW (20)	103.60 [c] ± 0.001	15.61 [c] ± 0.001	4.94 [c] ± 0.002
			HW (20)	103.30[d] ± 0.002	15.58[d] ± 0.002	4.91[d] ± 0.001
		F (40)	LW (20)	104.10 [c] ± 0.002	15.66 [c] ± 0.002	4.99 [c] ± 0.002
			HW (20)	103.80 [d] ± 0.002	15.63 [d] ± 0.002	4.96 [d] ± 0.002
Ana Sagar Site 5	*Lr* Overall value (80)			77.20 [b] ± 0.05	8.87 [b] ± 0.004	2.20 [b] ± 0.004
	Lr	M	LW	77.10 [c]	8.86 [c]	2.19 [c]

	(80)	(40)	(20)	± 0.001	± 0.001	± 0.001
			HW (20)	76.80[d] ± 0.001	8.83[d] ± 0.001	2.16[d] ± 0.001
		F (40)	LW (20)	77.60 [c] ± 0.001	8.91 [c] ± 0.001	2.24 [c] ± 0.001
			HW (20)	77.30 [d] ± 0.001	8.88 [d] ± 0.001	2.21 [d] ± 0.001
	Cc Overall value (80)			76.70 [b] ± 0.04	9.92 [b] ± 0.005	2.35 [b] ± 0.005
	Cc (80)	M (40)	LW (20)	76.60 [c] ± 0.001	9.91 [c] ± 0.001	2.35 [c] ± 0.001
			HW (20)	76.30[d] ± 0.001	9.88[d] ± 0.001	2.30[d] ± 0.001
		F (40)	LW (20)	77.10 [c] ± 0.001	9.96 [c] ± 0.001	2.39 [c] ± 0.001
			HW (20)	76.80 [d] ± 0.001	9.93 [d] ± 0.001	2.36 [d] ± 0.001
Foy Sagar	*Lr* Overall value (80)			80.00 [b] ± 0.04	9.15 [b] ± 0.005	2.98 [b] ± 0.005
	Lr (80)	M (40)	LW (20)	79.90 [c] ± 0.001	9.14 [c] ± 0.001	2.97 [c] ± 0.001
			HW (20)	79.60[d] ± 0.001	9.11[d] ± 0.001	2.94[d] ± 0.001

		F (40)	LW (20)	80.40 [c] ± 0.001	9.19 [c] ± 0.001	3.02 [c] ± 0.001
			HW (20)	80.10 [d] ± 0.001	9.16 [d] ± 0.001	2.99[d] ± 0.001
	Cc Overall value (80)			79.50 [b] ± 0.02	10.20 [b] ± 0.005	3.03 [b] ± 0.004
	Cc (80)	M (40)	LW (20)	79.40 [c] ± 0.001	10.19 [c] ± 0.001	3.03 [c] ± 0.001
			HW (20)	79.10[d] ± 0.001	10.26[d] ± 0.001	2.99[d] ± 0.001
		F (40)	LW (20)	81.90 [c] ± 0.001	10.24 [c] ± 0.001	3.07 [c] ± 0.001
			HW (20)	79.00 [d] ± 0.001	10.21 [d] ± 0.001	3.04 [d] ± 0.001

Figures in the parentheses indicate number of observations in each case:

Lr = *Labeo rohita* fish

Cc = *Catla catla* fish

M = Male

F = Female

LDH = Lactate dehydrogenase

AST = Aspartate aminotrasnferase

ALT = Alanine aminotransferase

[b] = Significant ($p \leq 0.05$) difference in overall mean values of LR and CC

[c] = Significant ($p \leq 0.05$) difference for LW in a fish type

[d] = Significant ($p \leq 0.05$) difference for HW in a fish type