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Changes in the level of transaminases in Indian major carp, *Labeo rohita* exposed to sublethal concentration of tannery and distillery effluents

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Abstract: *The activity of alanine aminotransferase (ALAT) and aspartate aminotransferase (AAT) of different tissues of fingerlings of Labeo rohita under the influence of two effluents has been studied. The alanine aminotransferase activity was increased over the control in different exposed periods of tannery and distillery effluent treatments. The alanine aminotransferase in the liver showed increased activity at different periods than that of the muscle, kidney, gill and brain ($p<0.001$) (60.09%) over the control during the 40 days exposure in both the effluents treatments. The increased activity of alanine aminotransferase was highly significant ($p>0.001$) in all the tissue in tannery and distillery effluents treatments. Similarly aspartate aminotransferase activity was increased over the control in all the treated tissues from 10 to 40 days exposure. But this increase was not significant in the muscle tissue in distillery and tannery treatements after 10 days exposure. From 10 to 40 days, the activity was increased but a maxmum elevation was observed during 40 days, where the elevation was more in the liver, which was followed by muscle, kidney, gill, brain (brain<gill<kidney<muscle<liver).*

Key words: *Tannery, Distillery, Effluents, Sublethal concentration, Indian major carp, Labeo rohita.*

Introduction

There are a number of chemicals in the environment, some of them are toxic and the rest are non-toxic. These toxic chemicals are discharged by industries into air, water and soil and they enter into food chain from the environment. Once they enter our biological system, they disturb the biochemical processes, leading in some cases to fatal results. In general, toxic chemicals attack the active sites of enzymes, inhibiting essential enzyme function. The tannery and distillery effluents contain different heavy metal ions such as chromium, sulphur, chloride etc. Depending on the composition and concentration, industrial effluents alter rate of feeding, digestion process of fishes (Webb and Brett, 1972, 1973) and indirectly alter the enzyme activity by infusing the substrate (Lehninger, 1982). The present study deals with the effect of tannery and distillery effluents on transaminase activities in the tissues viz. liver, muscle, kidney, gill and brain of Indian major carp, *Labeo rohita.*

Materials and Methods

Specimens of *Labeo rohita* (fingerlings) were collected from the Tamilnadu Fishery Department, Mettur Dam, Mettur and acclimatized to the laboratory conditions and feeding schedule for a period of 15 days at 25±1ºC was followed. The individuals were divided into two groups of 25 each. One group was treated with the tannery effluent and other with distillery effluent of their sub lethal concentration for a period of 10, 20, 30 and 40 days. The aquarium water was changed daily with same concentrations. After every period of experiments, the fishes were sacrificed and tissues of liver, muscle, kidney, gill and brain were taken for the enzyme analysis. The control was also maintained for the same period. The tissues were washed in distilled water and 10% homogenate of each tissue was prepared with double ionized distilled water. The homogenates were centrifuged at 5000 rpm for 10 min. The clear supernatant was used as enzyme source.

Alanine aminotransaminase and aspartate amino transaminase activities were measured spectrophotometrically according to Bergmeyer (1963) as modified by Butterworth and Probert (1970) using sodium pyruvate as the substrate. Protein content of the samples was estimated by following the method of Lowry *et al*. (1951) using bovine albumen serum as standard.

Results and Discussion

The activity of alanine aminotransaminase and aspartate aminotransaminase of different tissues of fingerlings of *Labeo rohita* under the influence of two effluents has been shown in Tables 1 and 2. The alanine aminotransaminase activity was increased over the control in different exposed periods of tannery and distillery effluent treatments. The alanine aminotransaminase in the liver showed increased activity at different periods than that of the muscle, kidney, gill and brain ($p<0.001$) (60.09%) over the control during the 40 days exposure period. The activity gradually rose from 10 days exposure to 40 days exposure in both the effluents treatments. The increase activity of alanine aminotransaminase was highly significant ($p>0.001$) in all the tissues in tannery and distillery effluents treatments.

Similarly aspartate aminotransaminase activity was increased over the control in all the treated tissues from 10 to 40

Table – 1: Alanine aminotransferase in different tissues of *Labeo rohita* exposed to sub lethal concentration of tannery and distillery effluents on different days exposure (µm pyruvate / mg protein / hr).

Tissues		10th day			20th day			30th day			40th day		
		Control	Tannery	Distillery	Control	Tannery	Distillery	Control	Tannery	Distillery	Control	Tannery	Distillery
Muscle	Mean ±	0.8000	0.9330	1.028	0.8280	1.088	1.099	0.8940	1.142	1.259	0.9130	1.190	1.301
	S.E %	0.0165	0.0130	0.0191	0.0172	0.0154	0.0199	0.0138	0.0233	0.0256	0.0159	0.0328	0.0258
			(16.63)	(25.5)		(31.40)	(32.73)		(27.74)	(40.83)		(30.34)	(42.5)
			(***)	NS		(***)	(***)		(***)	(***)		(***)	(***)
Liver	Mean ±	0.977	1.098	1.298	1.084	2.055	2.028	1.041	1.332	1.456	1.086	2.096	2.120
	S.E %	0.0209	0.0169	0.1288	0.0339	0.0808	0.0779	0.0404	0.0758	0.0980	0.0289	0.1021	0.1522
			(12.38)	(32.86)		(89.58)	(87.08)		(27.93)	(39.77)		(92.73)	(95.21)
			(*)	(*)		(***)	(***)		(**)	(***)		(***)	(***)
Kidney	Mean ±	0.3690	0.4700	0.4920	0.3800	0.5190	0.6020	0.4200	0.6400	0.7630	0.3920	0.7270	0.7560
	S.E %	0.0195	0.0200	0.0264	0.0199	0.0281	0.0244	0.0232	0.0269	0.0183	0.0203	0.0267	0.0241
			(27.37)	(33.33)		(36.58)	(58.42)		(52.38)	(80.95)		(85.46)	(92.86)
			(**)	(**)		(***)	(***)		(***)	(***)		(***)	(***)
Gill	Mean ±	0.1000	0.111	0.1270	0.1680	0.2230	0.2560	0.1850	0.2430	0.2880	0.1880	0.2580	0.3130
	S.E %	0.0078	0.0114	0.0123	0.0127	0.0157	0.0145	0.0064	0.0128	0.0128	0.0059	0.0111	0.0133
			(11.00)	(27.00)		(32.74)	(52.38)		(31.35)	(55.67)		(37.23)	(66.49)
			NS	NS		(*)	(***)		(***)	(***)		(***)	(***)
Brain	Mean ±	0.3680	0.4050	0.4380	0.3730	0.5120	0.5260	0.3880	0.5440	0.5600	0.3930	0.5750	0.5910
	S.E %	0.0157	0.0137	0.0288	0.0207	0.0174	0.0279	0.0095	0.0251	0.0304	0.4310	0.0246	0.0246
			(10.05)	(19.02)		(37.27)	(41.02)		(40.21)	(44.33)		(46.31)	(50.38)
			NS	(*)		(***)	(***)		(***)	(***)		(**)	(***)

*** $p < 0.001$ ** $p < 0.01$ * $p < 0.05$ NS – Not significant

Table 2: Aspartate aminotransferase in different tissues of *Labeo rohita* exposed to sub lethal concentration of tannery and distillery effluents on different days exposure (µm pyruvate / mg protein / hr).

Tissues		10th day			20th day			30th day			40th day		
		Control	Tannery	Distillery	Control	Tannery	Distillery	Control	Tannery	Distillery	Control	Tannery	Distillery
Muscle	Mean ±	0.1328	0.150	0.154	0.133	0.156	0.162	0.132	0.164	0.158	0.137	0.205	0.213
	S.E %	0.0022	0.0023	0.0022	0.0021	0.0021	0.0019	0.0023	0.0021	0.0049	0.0013	0.0035	0.0061
			(13.51)	(16.92)		(22.25)	(22.25)		(23.90)	(19.37)		(49.85)	(55.64)
			(***)	(***)		(***)	(***)		(***)	(***)		(***)	(***)
Liver	Mean ±	0.151	0.180	0.190	0.148	0.202	0.207	0.153	0.210	0.217	0.153	0.254	0.244
	S.E %	0.0007	0.0012	0.0015	0.0028	0.0009	0.0024	0.0028	0.0029	0.0029	0.0015	0.0042	0.0048
			(19.65)	(26.29)		(36.14)	(39.78)		(37.88)	(42.14)		(54.59)	(60.09)
			(***)	(***)		(***)	(***)		(***)	(***)		(***)	(***)
Kidney	Mean ±	0.066	0.084	0.084	0.073	0.104	0.105	0.068	0.102	0.108	0.070	0.106	0.111
	S.E %	0.0014	0.0009	0.0020	0.0022	0.0012	0.0017	0.0012	0.0012	0.0018	0.0013	0.0009	0.0009
			(27.36)	(31.46)		(42.72)	(44.78)		(50.74)	(59.59)		(50.71)	(59.14)
			(***)	(***)		(***)	(***)		(***)	(***)		(***)	(***)
Gill	Mean ±	0.055	0.066	0.068	0.055	0.073	0.079	0.059	0.081	0.089	0.055	0.066	0.068
	S.E %	0.0016	0.0020	0.0026	0.0016	0.0012	0.0015	0.0015	0.0015	0.0018	0.0016	0.0020	0.0026
			(19.86)	(22.92)		(32.49)	(43.56)		(36.32)	(50.51)		(19.86)	(22.93)
			(***)	(***)		(***)	(***)		(***)	(***)		(***)	(***)
Brain	Mean ±	0.803	0.942	0.965	0.820	0.991	1.024	0.803	0.992	1.080	0.815	1.082	1.128
	S.E %	0.0089	0.0094	0.0109	0.0103	0.0094	0.0140	0.0089	0.0141	0.0149	0.0081	0.0085	0.0161
			(17.31)	(20.17)		(20.85)	(24.88)		(23.54)	(34.50)		(32.76)	(38.40)
			(***)	(***)		(***)	(***)		(***)	(***)		(***)	(***)

*** $p < 0.001$ ** $p < 0.01$ * $p < 0.05$ NS – Not significant

Table – 3: Ritis Quotient (AAT / ALAT) in different tissues of *Labeo rohita* exposed to sublethal concentration of tannery and distillery effluents in different days of exposure.

S. No.	Tissues	10 day			20 day			30 day			40 day		
		Control	Tannery	Distillery	Control	Tannery	Distillery	Control	Tannery	Distillery	Control	Tannery	Distillery
1.	Muscle	0.165	0.161	0.129	0.161	0.143	0.147	0.147	0.143	0.125	0.150	0.172	0.164
2.	Liver	0.155	0.164	0.146	0.136	0.098	0.102	0.147	0.158	0.149	0.191	0.121	0.115
3.	Kidney	0.179	0.179	0.171	0.192	0.202	0.174	0.162	0.159	0.142	0.092	0.146	0.147
4.	Gill	0.550	0.594	0.535	0.327	0.327	0.308	0.318	0.333	0.309	0.293	0.256	0.217
5.	Brian	2.180	2.325	2.200	2.198	1.935	1.940	2.060	1.820	1.930	2.073	1.880	1.900

days exposure. But this increase was not significant (Table 2) in the muscle tissue in distillery and tannery treatments after 10 days exposure. The aspartate aminotransaminase activity also followed the same trend as alanine aminotransaminase throughout the study period. From 10 to 40 days, the activity was increased but a maximum elevation was observed during 40 days, where the elevation was more in the liver, which was followed by muscle, kidney, gill, brain (brain<gill<kidney< muscle<liver) (Table 2).

Transaminases play an important role at the junction between the carbohydrate and protein metabolism by interconverting the strategic compounds viz; ketoglutarate, pyruvate and oxaloacetate on one hand and alanine, aspartate and glutamate on the other hand. A close relationship exists between the mitochondrial intensity and transaminases level, (Baintenico, 1974) and any modification in the organization of mitochondria might alter the enzyme associated with it. In view of this, it may be suggested that chemicals which are present in the effluents might be acting on the carbohydrate metabolism. In the liver and kidney comparatively maximal alanine aminotransaminase and aspartate aminotransaminase activities existed in both tannery and distillery effluents to that of gill, muscle and brain. The increased transaminase activity might be due to increase in transamination reaction i.e. transferring of NH_2 group from amino acid to a ketoacid. Documented evidences showed that transamination and transdeamination reactions are prominent under stress condition (Rajender *et al*, 1986). In the case of aspartate aminotransaminase after the initial increase up to 10 days, it reached the maximum after 40 day (Table 2). In the case of alanine aminotransaminase also, same condition was observed which gradually reached its peak after 40 days exposure (Table 1). In most of the cases, it has been observed that different enzymes behave differently and even the same enzyme behave in different ways in different species (Banerjee *et al.,* 1992). Sarkar and Sastry (1992) have studied the activity of alanine aminotransaminase and aspartate aminotransaminase in non-target animals like rats and showed an increased activity under toxic exposure. In view of this, it may be said that effluents have stimulated the breakdown of carbohydrates and proteins resulting to amino acids leading to its accumulation and thereby elevating in transaminase levels reaching a maximum after 40 days exposure indicating the toxification mechanism in the animal. Further, a close relationship exists between the mitochondria intensity and transaminases level (Suhasini *et al*., 1979) and any change in the function of this organelle will reflect on the aminotranferases

In the present investigation, the de Ritis quotient, the ratio of aspartate aminotransaminase and alanine amino transaminase, has not changed. The value remained below 1, but never 2 in all the tissues expect in brain of both the treatments (Table 3) indicating that the variation in the level of activity of two amino transferases was minimal.

In the present study, the toxicity of the distillery effluent was higher than that of the tannery effluent and this may be due to concentration of the chemical constituents which were more in distillery effluent than that in tannery effluent. The fish are therefore, directly exposed to either treated or untreated effluents which may be toxic to them. Hence, the environmental awareness becomes more necessary, since fish forms delicious component of human food and further it is poor man's dish, it may be concluded that the effluents from tannery and distillery factories presently evaluated cause lethal effects found in the surrounding area whether terrestrial or aquatic. So proper treatment of effluents is a necessary prerequisite system or environment.

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