EFFECT OF SAGO EFFLUENT ON THE LEVELS OF THE ENZYME ALKALINE PHOSPHATASE ACTIVITY IN THE LIVER TISSUE OF THE FRESH WATER FISH *CLARIAS BATRACHUS*

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ABSTRACT

The aim of the study was to determine the effect of Sago effluent on the enzymeAlkaline phosphatase in the liver tissue of the fresh water fish *Clariasbatrachus*. The fish were exposed to control and different concentrations of treated sago effluents. The concentrations chosen were 25%, 50% and 75% of treated sago effluent. The levels of the enzyme decreased significantly in the liver tissue of the experimental fish *Clariasbatrachus*, when compared with that of controls.
Key words: Alkaline phosphatase, Sago effluent, *Clariasbatrachus*.

INTRODUCTION

The aquatic environment is the ultimate sink for all the environment pollutants any chemical pollutant either natural or synthetic is most likely to reach the aquatic environment sooner or later. The toxicity may be either acute or chronic to all forms of biota in aquatic system and also varies to different aquatic organisms. The toxic effects may include both lethal and sublethal concentrations, which may change the growth rate, development, reproduction, histopathology, biochemistry, physiology and behavior (Rand &Petrocelli, 1985).

Alterations in the physiological and biochemical parameters of toxicant treated fish have recently emerged as an important tool for the water quality assessment and to know the pathological status of fish in the field of environmental toxicology (Racicot *et al*., 1975; Wieser&Hinterleitner, 1980). The alteration in various physiological and biochemical parameters of an aquatic animal due to exposure of different toxicant has been shown to be directly or indirectly related to the behaviour, immune system, neurotranmission, energy matabolism and reproduction (Ekwoezor*et al*., 2001; Adeyemo, 2005).

Accumulation of the environmental pollutants and toxicants has been shown to cause alteration in the activity of many enzymes concerning to cellular energy metabolism (Niwelmski, 1990; Claireaux&Dutil, 1992; Sebert*et al*., 1993; Almeida *et al*., 1995).

Alteration in enzyme activities of the fish is one of the major biomarker indicating the level of changes consequent of pollutants in the tissues, organs and body fluid of the fish that can be recognized and associated with established health impairment process (Akinrotimi*et al*., 2009). Moreover, Gabriel and Akinrotimi (2011) noted that enzymes can be used to confirm and asses fish exposure to toxicants, providing a link between external and internal structure and degree of responses to toxicant exposure observed between different individuals. However, the applications of enzyme determinations in fish, as an indicator of chemical intoxication seem to be promising. It is most relevant and appropriate in sublethal exposure which spans over many

days (Cengiz and Vnlu, 2006). Toxicants also can inhibit the activity or synthesis of enzymes (Jung et al., 2003), resulting in decreased activities in the organs.

Alkaline phosphatase is a hydrolase enzyme responsible for removing phosphate groups from many types of molecules, such as, nucleotides, proteins and alkaloids. It is a P-stress marker enzyme most effective ion an alkaline environment, which catalyzes the hydrolysis of phosphorous compounds and the transfer of phospharyl groups to an acceptor molecule. The rate of catalytic activity of the enzyme is inversely proportional to the concentration of inorganic phosphate in the ambient environment (Dyhrman and Palanik, 1999). This enzyme could serve as a good indicator of intoxication because of its sensitivity to metallic salts (Boge*etal.,* 1992).

Fish are sensitive indicators of pollutants present in water. These pollutants cause various physiological and physical alterations in fishes. In the present work alternations in the activityof theenzyme Alkaline phosphatase has been evaluated in the liver tissue of the fresh water fish *Clariasbatrachus*.

MATERIALS AND METHODS

The Sago industry effluents were collected from a private Sago industry, situated at Ponnachi near Ammapet of Erode District, Tamil Nadu, India. The effluent from the industry was collected and transported to the laboratory and used for further experiments. Fingerlings of healthy *Clariasbatrachus* were brought to the laboratory and acclimatized for 15 days. The fish were well fed during the acclimatized period. Then fish were exposed to control and 25%, 50%, 75% concentrations of treated sago effluents for period of 28 days. Feeding was stopped one day before commencement of the experiment.

For the enzyme assay, the liver of six fishes were cut and homogenized with cold distilled water and centrifuged at 7000 RPM for about 7 minutes. The supernatant was taken for assay. The enzyme activities were estimated by GCCA / kinetic method of Anonymous (1970, 1972) and Webinar *et al*., (1975).

RESULTS

The results of the enzymes activities in response to sublethal exposure of sago effluents are shown in Table 1 and Figure 1& 2. The values of ALP, obtained in liver decreased with increasing the concentrations of the effluents. The control group recorded 41.3u/l whereas the experimental groups such as 25%, 50% and 75% treated sago effluent showed 32.5u/l, 20.3u/l and 11.2u/l respectively.

Table.1. Levels of Alkaline phosphatase activity in the liver tissue of *Clariasbatrachus* exposed to control and different concentrations of sago effluent.

Effluent concentration	ALP activity u/l
Control	41.3 u/l
25%	32.5 u/l
50%	20.3 u/l
75%	11.2 u/l

Fig.1. Levels of Alkaline phosphatase activity in the liver tissue of the fish *Clariasbatrachus* exposed to control ad different concentrations of sago effluent.

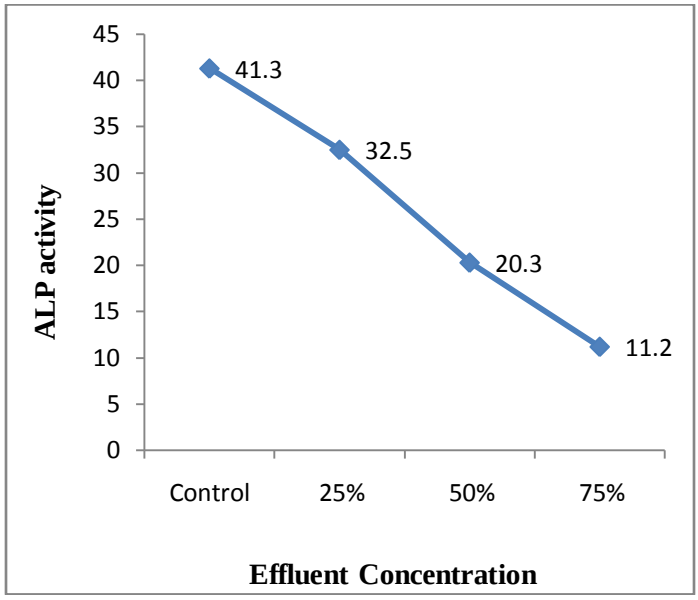
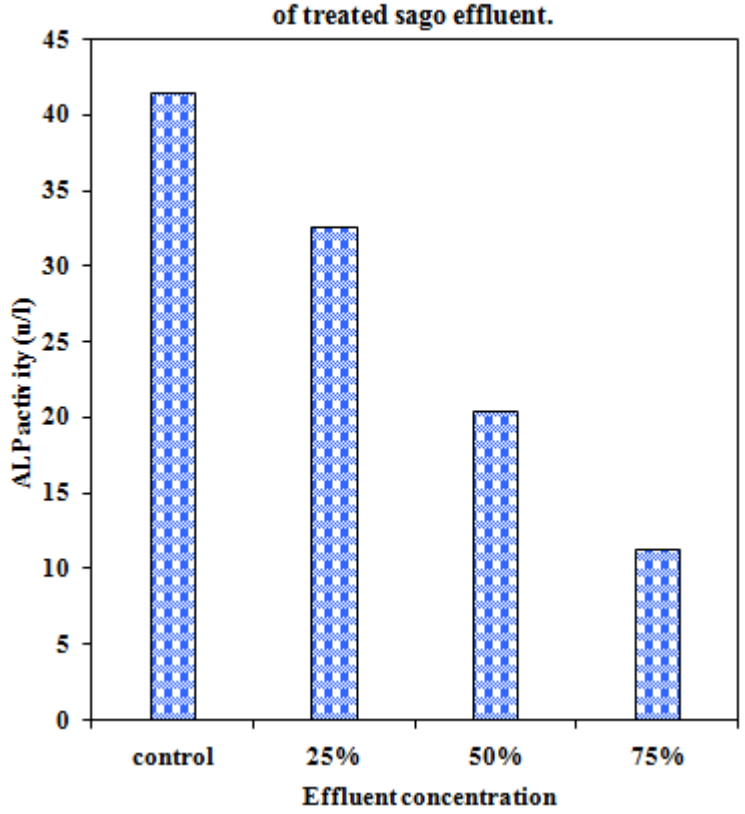


Fig.2. Alkaline phosphatase levels in the liver tissues of *Clarias batrachus* on exposure to control and different concentrations of treated sago effluent.



DISCUSSION

Enzymes are fragile substances with a tendency to undergo denaturation and inactivation under unsuitableconditions. The variations in the activity of acid phosphatase enzyme in liver of freshwater fish *Clariasbatrachus*exposed to sago effluent was studied in the present investigation. Alkaline phosphataseis a general enzyme presentin almost all the tissues. It is a hydrolytic enzyme concerned with the process of transphosphorylationand have an important role in the general energetics of an organism. It is associated with the transport of metabolites, with metabolism of phospholipids, phosphoproteins, nucleotides and carbohydrate, and with synthesis of proteins (Srivastava*et al*., 1995).

In the present investigation a marked decrease in the activities of the enzyme alkaline phosphatase has been observed with increasing the concentrations of the effluents. Variation in the metabolic enzyme activities in fish is directly proportional to the concentration of the toxicant (*Pesce et al.,* 2009).Similar observations have been made by Chetna and Aditi (2011) in the liver of fish *Cyprinuscarpio* exposed to steel plant effluent. Kamble*et al*., (2011) have studied the decreased activity of ALP in liver, muscle and kidney of the fish *Bariliusburna* exposed to dimecron.Similar decreasing trends were observed in *Ophiocephaluspunctatus* exposed to copper and in *Notopterusnotopterus* exposed to phenolic compounds (Dalela*et al*., 1982). The accumulation of toxicants beyond a tolerable level in the liver might cause such enzymatic changes. The phosphatases (ACP and ALP) are important biomarkers because they are involved in adaptive cellular response to the potential cytotoxicity and genotoxicity of pollutants (Leohner*et al*., 2001).Decline in ALP activity may result from in the rate of synthesis of glycogen caused by lowered metabolic demands and electrolytic imbalance due to tissue overhydration (Shaffi, 1979).Sunmono*et al*., (2009) studied the Anthracene induced enzymatic changes as stress indicators in African Catfish *Heterobranchusbidorsalis* and found significant inhibition of ALP in liver with increasing concentration. According to them, decrease in ALP is possibly due to leakage of the enzyme from cytosol across the damaged plasma membrane in to the general blood circulation or decreased enzyme synthesis on account of organ dysfunction. Alkaline phosphatase is a membrane bound enzyme found in at bile pole of hepatocytes, pinocytic vesicle and golgi complexes. It is present on all cell membranes where active transport occurs, hence is often employed to assess the integrity of the plasma membrane (Akanji*et al*., 1993). The present author agrees with the above mentioned workers that the rapid decrease in the activity of ALP may be indicative of an enzymatic derangement and the onset of degenerative changes taking place in the membrane transport system.ACP and ALP are mainly involved in the catabolic and autophagic processes in the cells. Their decreased synthesis or increased rate of degradation targets the lysosomal disruption (Palanisamy*et al*., 2012). The decreased activities of these enzymes indicate disturbance in the structure and integrity of cell organelles, like endoplasmic reticulum and membrane transport system. (Nchumbeni*et al*., 2007).

From the above findings, the results of this present investigation clearly confirm the fact that the decrease in the activity could be due to disturbance in the structure and integrity of cell organelles.

REFERENCES

Adeyemo, O.K. (2005). Hematological and histopathological effects of cassava mill effluent in *Clariasgariepinus. Afr. J. Biomed Res 8,* 179-183.

Akanji, M.A., Olagoke, O.A. &Oloyede, O.B. (1993) Effect of chronic consumption of metabisulphite on the integrity of the kidney cellular system.*Toxicol*. 81:173-179

Akinrotimi, O.A., Abu, O.M.G., Ansa, E.J., Edun, O.M. & George OS (2009) Haematological responses of *Tilapia guineensis* to acute stress. *J Nat Appi Sci*. 5:338 - 343.

Almeida–Val, V.M.E., Farias, I.P., Silva, M.N.P., Duncan, W.P. &Val.A.L.(1995).Biochemical adjustments to hypoxia by Amazon cichids*Braz. J. Med Biol.Res 28,* 1257-1263.

Anonymous (1970). Z. *Klin. Chem. Klin. Biochem.*8 , 658.

Anonymous (1972).*Z. Klin. Chem. Klin. Biochem.*10 , 182.

Boge, G., Leydet, M. &Houvet, V. (1992) The effects of hexavalent chromium on the activity of alkaline phosphatase in the intestine of Rainbow trout *Oncorhynchusmykiss. Aquatic.Toxicol*.23:247.

Cengiz, E.J. &Vnlu, E. (2006) Sublethal effects of commercial deltamethrin on the structure of the gill, liver and gut tissues of mosquito fish, *Gambusiaaffiis* microscopic study. *Environ. Toxicol.Pharmacol.* 21:246-253.

Chetna, B. &Aditi, N. P. (2011) Effect of steel plant effluent on acid and alkaline phosphatase of gills, liver and gonads of *Cyprinuscarpio. Int.J. Environ.Sci*. Vol.1.No.6: 1305-1316.

Claireaux,G&Dutil, J.D. (1992). Physiological responses of Atlantic cod (*Gadusmorrhna*) to hypoxia at various environmental salinities. *J. Ep.Biol 163,* 97-118.

Dalela, R.C., Rani, S &Verma, S. R. (1980) Physiological stress induced by sublethal concentration of phenol and pentachlorphenol in *Notopterusnotopterus* hepatic acid and alkaline phosphatases and succinic dehydrogenase. *Environ. Pollut.* 21: 3-8.

Dyhrman, S.T. &Palanik, B. (1999) Phosphatase stress in *Labeorohita* fingerlings: Biochemical enzymatic and haematological consequence. *Comp. Biochem. Physiol.Toxicol. Phamacol*. 137: 325-333.

Ekweozor, I.K.E., Bobmanuel, N.O.K. & Gabriel, U.U. (2001).Sublethal effect of ammonial

fertilizer effluents on the three commercial species from Niger Delta area. *J.*

app.Sci.Environ Mange 5, 63-68.

Gabriel, U.U. &Akinrotimi, O.A. (2011) Management of stress in fish for aquaculture development.*Researcher*. 3(4): 28-38.

Jung, S.H., Sim, D.S. & Kim, Y. (2000) Effects of formalin on haematological and blood chemistry in olive flounder *Paralichthysolivaceus. Aquat.Res.*34: 1269-1275.

Kamble, S. M., Bhagwan, H. K. &Pulate. V. M. (2011) Effect of sublethal concentration of dimecron on acid phosphatase and alkaline phosphatase activities in liver, muscle and kidney of a fresh water fish *Bariliusburna*. *Int. Ref. Res. J*.Vol.2 (19): 46-47.

Leohner, T. W., Reash, R.J. & Williams, M. (2001) Assessment of tolerant sunfish populations (*Lepismisspp*) inhabiting selenium-laden coal ash effluent.Tissue biochemistry evaluation.*Ecotoxicol.Environ.Saf*.50: 217-224.

Niwelinski, J., Zamorska, L., Kaczarski, F. &Pawlicki, R. (1990).Enzyme histochemistry and microstructure of the human placenta as indicators of environmental pollution.ArchiwumochronySrodowiska 3, 53-59.

Palanisamy, P., Sasikala, G., Mallikaraj, D., Bhuvaneswari, N. &Natarajan, G.M. (2012) Activity levels of phosphatases of the air-breathing catfish *Mystuscavasius* exposed to electroplating industrial effluent chromium. *Biol. Med*. 4(2): 60-64.

Pesce, S.F., Cazenave, J., Monferra, M.N., Frede, S. &Wunderlin, D.A. (2009) Integrated survey on toxic effects of indane on neotropical fish; *Corydoraspaleatus* and *Jenynsiamultidentata*. *Environ. Poll.*156:775-783.

Racicot, Y.C., Gander, M. &Leay, C. (1975). Blood and liver enzymes in rainbow trout (*Salmogairdneri* Rich.) with emphasis in their diagnostic study of CCl4 toxicity and a case of aeromonas infection.*J. Fish Biol. 7*, 825.

Rand, G.M. &Petrocelli, S.R. (1985).*In*: 'Fundamentals of Aquatic Toxicology Methods and Applications'. (Eds.). *Hemisphere Publishing Corporation*, Washington, U.S.A., pp.1-28.

Sebert, P., Simon, B. &Barthelemy. (1993). Hydrostatic pressure induces a state resembling histotoxic hypoxia in *Anguilla Anguilla*. *Comp. Biochem. Physiol. 105* B, 255-258.

Shaffi, S.A. (1979) Effects of starvation on tissue and serum gluconeogenic enzyme, alkaline phosphatase and tissue glycogen in the fresh water catfish, *Heteropneutesfossilis* (Bloch). *Acta. Physiol. Acad. Sci. Hung*. 53(4): 50501-505.

Srivastava, A.K., Roy, D.,Sinha, N. D.&Srivastava, S. J. (1996) Dyes induced changes in the haematological parameters of fresh water cat fish *Heteropneustesfossilis*. *Econ.Env. Conserve. 2 (3&4):*155-158.

Sunmonu, T.O., Owaolabi, O.D. &Ololyede, O.B. (2009) Anthracene induced enzymatic changes as stress indicators in African catfish, *Heterobranchusbidorsalis*Geoffroy Saint Hilaire, 1809. *Res. J. Environ. Sci*.3(6): 677-686.

Weibhaar D *et al.* (1975). *Med. Welt.*26 : 387.

Wieser, W. &Hinterleintner, S. (1980). Serum enzymes in rainbow trout as tools in the diagnosis of water quality. *Bull. Environ. contam. Toxicol.25*, 188-193.