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Research Article

INFLUENCE OF DIMERCAPROL-(BAL) ON THE EFFECT OF MERCURY AND LEAD ON SELECTED ON THE BIOCHEMICAL CONSTITUENTS AND SELECTED ENZYMES SDH AND GDH OF THE MATERNAL AND EMBRYONIC TISSUES OF H.FULVIPES

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ABSTRACT

Heavy metal poisoning is treated often with antidotes which detoxify through the mechanism of chelation and revert the toxic effects. Dimercaprol (2,3-dimercapto propanol, British anti lewisite-BAL) is an antidote used to treat mercury and lead poisoning. Studies on detoxifying effects of dimercaprol when pregnant females are subjected to heavy metal poisoning in non-Mammalian subjects are totally lacking. The scorpion Heterometrous fulvipes provides an ideal non- mammalian viviparous system ideally suited for any studies aimed at comprehending the effects of maternal exposure to toxicants on development of young ones. Hence an attempt is made here to study the effects of the heavy metals, mercury and lead an the maternal animal and the developing embryos of H.fulvipes. Influence of dimercaprol on the effects of mercury and lead on the selected enzymes SDH and GDH of the maternal and embryonic tissues of H.fulvipes.

INTRODUCTION

The toxic sequelae of heavy metal action on tissues result in primary biochemical lesion whereby a critical enzyme or metabolic process is inhibited. Stated that cel1 membrane is the first site of attack by heavy metals .Cell membrane is known to contain sulfhydryl groups that are essential to the normal permeability and transport of materials. The same sulfhydryl groups are known to have a very high affinity for mercury, lead and other heavy metals. Almost all proteins contain sulfhydryl groups that are metal reactive. As the sulfhydryl groups are important in most protein functions, heavy metals can disturb almost all functions in which Proteins are involved. Thus, almost every protein in the body is a potential target.

In other words, heavy metals are potent but non-specific enzyme poisons.

Dimercaprol calcium edetate pencil amine, prednisone EDTA. (monocalcium ethylene diamine tetra acetic acid) are the common chelating agents which may be used in treating cases of acute and chronic heavy metal poisoning .These heavy metal antagonists (chelating agents) prevent or reverse toxic effects and enhance the excretion of the metals.

Mercury toxicity is associated to its high affinity for sulphonyl groups (-SH), forming stable complexes and causing several alterations, such as structural changes of sulfhydryl enzymes and the inactivation of their active sites (Rooney, 2007). Thus, the binding of mercury to-SH groups of antioxidants, for instances glutathione (GSH), reduces the capacity of reactive species (RS) neutralization. The reduction on antioxidant defenses added to the fact that mercury exposure can increases RS levels results in an imbalance in the pro-oxidants/antioxidant system, generating a condition of

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oxidative stress (Farina *et al*., 2003; Agarwal *et al*., 2010). In addition, several studies have shown that inorganic mercury exposure causes changes in body and organ weight, decreases in renal d-aminolevulinic acid dehydratase (d-ALA-D) activity, increase in serum urea and creatinine levels, as well as renal histopathological damages (Favero *et al*., 2014); Fransiscato *et al*., 2011; Oliveira *et al*., 2014); Peixoto and Pareira, 2007. Furthermore, although the liver is not the preferential target organ, alterations in hepatic enzymes have been observed (Mores-Silva *et al*., 2012; Oliveira *et al*., 2014; Peixoto and Pereira, 2007).

Reported sources of heavy metals in the environment include geogenic, industrial, agricultural, pharmaceutical, domestic effluents, and atmospheric sources (HeZl,YangXE, Stoffella PJ 2005). Industrial sources include metal processing in refineries, coal burning in power plants, petroleum combustion, nuclear power stations and high tension lines, plastics, textiles, microelectronics, wood preservation and paper processing plants (Aruti.A, Fernandez-OlmoL, Irabien A (2010), StraterE, WebtbeldA, Klemm O,(2010), Pacyna JM (1996) .One of the mechanism by which arsenic exerts its toxic effect in through impairment of cellular respiration by the inhibition of arsenic results from its ability to interact with sulfhydryl groups of proteins and enzymes, and to substitute phosphorous in variety of biochemical reactions(Wang Z.Rossman TG 1996).

Recovery of the altered biochemical and In lead poisoned children receiving 5 day courses of 1000mg of Ca.disodium EDTA Per M^2 of surface area per day, given intramuscularly both blood lead and Plasma zinc concentrations were reduced rapidly (Thomas and ChisoI m, 1986).

In rabbits given BAL or TA, parenterally, the amount of arsenic Oxide absorbed in the blood from the intestine was considerably lower than in control animals Recent studies with the antidote 2, 3-dimer captopropane-1-sulphonate indicated that treatment of lead poisoned children with this agent results in increased urinary loss of lead and a decline of lead in blood (Chisolm and Thomas, 1985).

It is thus clear that chelating agents like BAL serve as antidote by reducing the toxic effects of the heavy metals. It is, therefore, tempting to examine whether the effects of the toxic metals can be reversed or nullified if BAL is administered at the time of heavy metal exposure. It is all the more important to examine whether the antidotes can provide safety and protection to the fetus in viviparous systems when the mother is exposed to heavy metals during the gestation period. Hence, an attempt is made here to investigate the impact of the antidote dimercaproI, on the toxic effects of mercury and lead on the biochemical constituents and levels of activity of some enzymes in the maternal tissues and the embryos during gestation period of the scorpion H. fulvipes.

MATERIAL AND METHODS

Four sets of the gravid females one set each month during October December February and April were isolated from the main stock. Each set was divided into five batches. One batch was administered a sublethal dose of mercuric chloride and another batch received a sublethal dose of lead acetate. The third batch of scorpions received a sublethal dose of mercury as administered earlier to batch one along with dimercaprol 0.01 mg per gm body weight of scorpion. Batch four received the same quantity of dimercaprol along with the sublethal dose of lead. Fifth batch of gravid females received distilled water and served as controls.

The scorpions were sacrificed on the third day and the biochemical constituents like glycogen glucose, proteins TNPs and lipids, and the levels of activity of the enzymes AAT ALAT, SDH and GDH were determined in the maternal tissues and embryos in order to evaluate the antidotal effect of dimercaprol on the impact of lead and mercury.

The biochemical constituents, glycogen, glucoseproteins TNPS and lipids were estimated using the methods as described in chapter II. The levels of activity of AAT, ALAT, SDH and GDH were estimated.

Table 37 (Table 37a, Table 37b & Table 37c) Levels of Glycogen in Heapatopancreas, Pedipalpal Muscle and Embryo of H. Fulvipes treated with (a) Mercury (b) Mercury + Dimercaprol (c) Lead (d) Lead + Dimercaprol during different months of gestation N = 8

Table 37a	Glycogen (ug/100mg wet. Wt.) Hepatopancreas			
Treatment	October	December	February	April
Control	140.40±6.80	167.05±5.52	170.92±5.84	117.28±1.09
Mercury	129.91±4.81^{b}	145.82±6.07^{c}	142.63±5.93^{C}	83.33±3.60^{C}
Hg + dimercaprol	138.87±4.79^{a}	146.15±6.07*	143.26±5.78*	84.037±3.53*
Lead	116.17±4.73^{C}	135.99±3.36^{C}	135.90±3.38^{C}	90.62±3.42^{C}
Lead + dimercaprol	116.56±4.74*	134.02±3.90*	140.65±5.06^{a}	91.02±3.35*

Table 37b	Glycogen (ug/100mg wet. Wt.) Pedipalpal Muscle			
Treatment	October	December	February	April
Control	134.48±19.62	156.66±14.47	156.6±7.67	138.08±21.5
Mercury	110.18±10.96^{b}	108.33±9.62^{C}	112.03±18.48^{C}	79.62±17.17^{C}
Hg + Dimercaprol	113.30±11.07*	109.71±9.08*	112.25±18.66*	80.87±18.61*
Lead	101.84±17.47^{b}	109.25±9.96^{C}	101.84±17.47^{C}	72.18±14.17^{C}
Lead + Dimercaprol	113.02±17.66^{a}	109.40±9.98*	103.14±17.53*	72.43±14.19*

Table 37c	GLYCOGEN (ug/100mg wet. Wt.) EMBRYO			
Treatment	October	December	February	April
Control	1.33±0.03	2.72±0.08	5.72±0.17	42.03±0.43
Mercury	1.23±0.03^{C}	2.35±0.12^{C}	4.96±0.28^{C}	40.16±0.81^{C}
Hg + dimercaprol	1.24±0.04*	2.38±0.11*	4.970.31*	40.25±0.83*
Lead	1.21±0.03^{C}	2.35±0.11^{C}	4.90±0.29^{C}	38.67±0.65^{C}
Lead + dimercaprol	1.22±0.03*	2.44±0.15*	4.81±0.36*	38.83±0.61*

b_p< 0.01; c_p< 0.001; * - insignificant

Table 38 (Table 38a and Table 38b) Levels of Glucose in Heapatopancreas and Heamolymph of H. Fulvipes treated with (a) Mercury (b) Mercury + Dimercaprol (c) Lead (d) Lead + Dimercaprol during different months of gestation N = 8

Table 38a	Glucose (µg/100mg wet weight) Heapatopencreas			
Treatment	October	December	February	April
Control	1.32±1.15	74.80±2.81	60.17±3.66	75.44±2.88
Mercury	116.42±2.34^{C}	61.60±3.32^{C}	49.07±3.19^{C}	56.33±2.11^{C}
Hg + dimercaprol	116.95±2.40*	62.18±3.18*	49.14±1.13*	56.73±2.05*
Lead	112.51±2.09^{C}	59.81±3.74^{C}	48.45±1.76^{C}	54.76±2.10^{C}
Lead + dimercaprol	112.48±1.92*	65.51±3.76*	48.77±1.82*	55.25±2.14*

Table 38b	Glucose (µg/100mg wet weight)			
	Heamolymph			
Treatment	October	December	February	April
Control	14.02±0.49	12.37±0.57	12.72±0.57	13.05±0.55
Mercury	15.91±0.57^{C}	14.56±0.56^{C}	15.23±0.73^{C}	14.93±0.74^{C}
Hg + dimercaprol	13.83±0.51^{C}	12.26±0.55^{C}	12.62±0.57^{C}	13.05±0.54^{C}
Lead	16.18±0.71^{C}	14.93±0.60^{C}	15.51±0.72^{C}	15.40±0.75^{C}
Lead + dimercaprol	13.89±0.51^{C}	12.30±0.56^{C}	12.71±0.48^{C}	13.02±0.64^{C}

c_p< 0.001; * insignificant

RESULTS

Effect of dimercaprol on the glycogen content of the maternal tissues and embryos of H. fulvipes exposed to mercury and lead during the gestation Period.

As could be noted in the figures 46, 47, 48 and Table 37, administration of sublethal doses of mercury and lead to the maternal animal lowered the glycogen content significantly in the hepatopancreas and the pedipa1pal muscle of the mother and the embryos throughout the gestation period Administration of the antidote, BAL did not bring a significant effect by way of reversal of the impact of the heavy metals in all cases during the gestation period, though indications are there.

Table 40 (Table 40a, Table 40b, Table 40c and Table 40d) Levels on TNPS in Heapatopancreas, Pedipalpal Muscle, Heamolymph and Embryo of H. Fulvipes Treated with (a) Mercury (b) Mercury + Dimercaprol (c) Lead (d) Lead + Dimercaprol during different months of gestation N= 8

Table 40a	TNPS (µg/100mg wet weight)			
	Heapatopencreas			
Treatment	October	December	February	April
Control	2.32±0.13	3.30±0.22	3.18±0.28	2.40±0.14
Mercury	2.55±0.13^{b}	3.42±0.13^{b}	3.40±0.28^{b}	2.94±0.15^{b}
Hg + dimercaprol	2.26±0.12^{C}	3.21±0.22^{a}	3.14±0.28*	2.43±0.14^{C}
Lead	2.05±0.19^{b}	2.85±0.10^{C}	2.72±0.19^{C}	1.92±0.10^{C}
Lead + dimercaprol	2.07±0.19*	2.90±0.10*	2.73±0.19*	1.96±0.11*

Table 40b	TNPS (µg/100mg wet weight)			
	Pedipalpal Muscle			
Treatment	October	December	February	April
Control	2.08±0.16	2.32±0.17	3.52±0.15	2.57±0.17
Mercury	2.32±0.13^{b}	2.71±0.16^{C}	4.09±0.11^{C}	2.90±0.10^{C}
Hg + dimercaprol	2.04±0.16^{b}	2.29±0.15^{a}	3.49±0.14^{C}	2.51±0.17^{C}
Lead	1.93±0.10^{a}	2.16±0.10^{a}	3.06±0.10^{C}	2.40±0.14^{a}
Lead + dimercaprol	1.95±0.10*	2.20±-0.10*	3.10±0.10*	2.45±0.14*

Table 40c	TNPS (µg/100mg wet weight)			
	Heamolympth			
Treatment	October	December	February	April
Control	25.99±1.24	30.90±1.02	31.72±1.29	30.17±1.14
Mercury	28.72±1.21^{C}	33.25±1.19^{C}	34.79±1.65^{a}	33.11±1.24^{C}
Hg + dimercaprol	25.21±1.13^{C}	30.28±0.88^{C}	30.78±1.21^{C}	30.00±1.09^{C}
Lead	23.64±1.01^{C}	27.16±1.58^{C}	28.00±1.15^{C}	26.14±1.14^{C}
Lead + dimercaprol	24.41±0.96*	27.63±1.47*	28.33±1.13*	27.00±1.08*

Table 40d	TNPS (µg/100mg wet weight)			
	EMBRYO			
Treatment	October	December	February	April
Control	0.11±0.008	0.40±0.03	0.60±0.01	1.36±0.11
Mercury	0.120±0.006^{C}	0.44±0.02^{b}	1.20±0.02^{C}	1.44±0.12*
Hg + dimercaprol	0.090±0.006^{C}	0.30±0.02^{C}	0.55±0.01^{C}	1.31±0.10^{a}
Lead	0.081±0.004^{C}	0.34±0.03^{C}	0.54±0.04^{b}	1.27±0.11*
Lead + dimercaprol	0.091±0.004^{a}	0.38±0.03^{a}	0.59±0.04*	1.29±0.11*

a_p< 0.05; b_p< 0.01; c_p< 0.001 * insignificant

Effect of dimercaprol on the glucose content of hepatopancreas and haemolymph of H. fulvipes exposed to mercury and lead during the gestation period.

Table 39 (Table 39a, Table 39b, Table 39c and Table 39d) Levels of proteins in Heapatopancreas, Pedipalpal Muscle, Heamolymph and Embryo of H. Fulvipes treated with (a) Mercury (b) Mercury + Dimercaprol (c) Lead (d) Lead + Dimercaprol during different months of gestation N= 8

Table 39a	Protein (mg/100mg wet weight)			
	Heapatopancreas			
Treatment	October	December	February	April
Control	18.37±0.50	16.41±0.36	14.72±0.35	17.52±0.46
Mercury	14.20±0.56C	14.46±0.71C	13.00±0.54C	16.01±0.46C
Hg + dimercaprol	14.40±0.56*	14.70±0.71*	13.10±0.56*	16.15±0.47*
Lead	13.32±0.68C	13.68±0.75C	11.78±0.62C	15.78±0.75C
Lead + dimercaprol	13.56±0.66*	13.80±0.73*	12.00±0.67*	15.90±0.76*

Table 39b	Protein (mg/100mg wet weight)			
	Pedipalpal Muscle			
Treatment	October	December	February	April
Control	12.55±0.66	12.00±0.61	13.27±0.47	13.61±0.45
Mercury	11.36±0.82a	10.52±0.47C	11.45±0.54C	12.20±0.48C
Hg + dimercaprol	11.70±0.81*	10.73±0.44*	11.65±0.58*	12.37±0.48*
Lead	11.23±0.65C	10.10±0.40C	11.25±0.61C	12.01±0.42C
Lead + dimercaprol	11.52±0.62*	10.65±0.48b	11.40±0.61*	12.11±0.38*

Table 39c	Protein (mg/100mg wet weight)			
	Heamolymph			
Treatment	October	December	February	April
Control	8.31±0.21	7.96±0.24	5.04±0.26	3.90±0.18
Mercury	7.30±0.26^{C}	6.64±0.31^{C}	4.54±0.21^{C}	3.61±0.23^{b}
Hg + dimercaprol	7.35±0.25*	6.65±0.31*	4.54±0.21*	3.66±0.23*
Lead	7.12±0.29^{C}	6.54±0.27^{C}	4.47±0.22^{C}	3.59±0.22^{b}
Lead + dimercaprol	7.12±0.28*	6.55±0.27*	4.49±0.21*	3.36±0.25*

Table 39d	Protein (mg/100mg wet weight)			
	Embryo			
Treatment	October	December	February	April
Control	0.06±0.01	0.11±0.04	0.31±0.09	2.33±0.62
Mercury	0.06±0.01*	0.11±0.20*	0.27±0.09*	2.13±0.64^{a}
Hg + dimercaprol	0.06±0.01*	0.11±0.01*	0.27±0.09*	2.14±0.64^{a}
Lead	0.06±0.01*	0.12±0.02^{a}	0.26±0.09*	1.99±0.50^{a}
Lead + dimercaprol	0.06±0.01*	0.11±0.01*	0.26±0.09*	1.94±0.51*

a_p< 0.05; bp< 0.01; c_p< 0.001 * insignificant

The glucose content of the hepatopancreas was depressed significantly by the single sublethal dose of both mercury and lead during different months of the Figs 46, 47 and 48. Effect of dimercaprol on the glycogen content of the embryos (Fig. 46) pedi pal palmuscle (Fig. 47) and hepatopancreas (Fig. 48) of H. fulvipes exposed to mercury and lead during different months of gestation period Administration of dimercaprol along with the same dose of mercury or lead did not significantly alter the glucose levels on the third day of administration of BAL by way of nullifying the effect of the heavy metals (Table 38 Fig. 50).

Glucose levels of hemolymph were elevated by both mercury and lead administered at different months of gestation. Dimercaprol administered along with mercury or lead significantly reversed the hyperglycemic effect of the heavy metals and brought back the glucose levels to the control levels (Table 38 Fig. 49) as evidenced by the glucose levels determined on third day.

Table 41 (Table 41a, Table 41b, Table 41c and Table 41d) Levels of Lipid in Hepatopancreas, Pedipalpal Muscle, Heamolymph and Embryo of H. Fulvipes with (a) Mercury (b) Mercury + Dimercaprol (c) Lead (d) Lead + Dimercaprol during different months of gestation N= 8

Table 41a	LIPID (mg/100mg wet weight) Heapatopancreas			
Treatment	October	December	February	April
Control	28.52±0.95	25.01±0.72	22.00±0.62	18.19±0.46
Mercury	27.16±0.98^{b}	22.69±0.81^{C}	19.17±0.53^{C}	16.59±0.32^{C}
Hg + dimercaprol	27.45±0.83*	24.50±0.86^{a}	21.03±0.43^{C}	17.52±0.34^{b}
Lead	24.87±0.80^{C}	24.00±0.84^{C}	18.01±0.51^{C}	15.62±0.65^{C}
Lead + dimercaprol	25.15±0.85*	24.60±0.98*	18.29±0.40*	17.64±0.29^{C}

Table 41b	LIPID (mg/100mg wet weight) Pedipalpal Muscle			
Treatment	October	December	February	April
Control	1.33±0.55	1.25±0.02	1.22±0.03	1.08±0.04
Mercury	1.23±0.07^{b}	1.13±0.04^{C}	1.12±0.04^{C}	1.02±0.05^{b}
Hg + dimercaprol	1.31±0.07^{a}	1.20±0.05*	1.19±0.03^{b}	1.04±0.04*
Lead	1.21±0.07^{b}	1.12±0.03^{C}	1.18±0.02^{a}	0.97±0.05^{b}
Lead + dimercaprol	1.28±0.07*	1.16±0.03^{a}	1.20±0.03*	1.05±0.03^{b}

Table 41c	LIPID (mg/100mg wet weight) Heamolymph			
Treatment	October	December	February	April
Control	421.00±12.52	418.37±10.71	385.62±10.43	366.25±8.11
Mercury	373.12±7.59^{C}	370.12±8.65^{C}	352.50±10.26^{C}	315.62±5.18^{C}
Hg + dimercaprol	383.12±8.19^{a}	376.25±7.00*	368.75±8.20^{b}	326.00±6.54^{C}
Lead	358.75±8.13^{C}	348.12±6.81^{C}	335.62±8.50^{C}	303.00±4.24^{C}
Lead + dimercaprol	370.00±6.49^{b}	358.75±5.84^{b}	350.00±8.16^{b}	310.62±4.79^{b}

Table 41d	LIPID (mg/100mg wet weight) Embryo			
Treatment	October	December	February	April
Control	0.11±0.007	0.27±0.01	2.64±0.03	3.26±0.09
Mercury	0.012±0.004^{a}	0.24±0.01^{C}	2.31±0.04^{C}	2.95±0.12^{C}
Hg + dimercaprol	0.014±0.004*	0.25±0.01*	2.35±0.05*	3.01±0.11*
Lead	0.013±0.006^{b}	0.23±0.01^{C}	2.09±0.03^{C}	2.84±0.13^{C}
Lead + dimercaprol	0.013±0.07*	0.24±0.01*	2.10±0.03*	2.86±0.13*

a_p< 0.05; b_p< 0.01; c_p< 0.001 * insignificant

Effect of dimercaprol on the TNPS content of maternal tissues and embryos of H fulvipes exposed to mercury and lead during the gestation period.

The total ninhydrin Positive substances of the hepatopancreas hemolymph and maternal tissues pedipal Pal muscle were elevated by the sublethal dose of mercury administered in the present study at all times during the gestation period. Administration of Figs. 49 and 50.

Effect of dimercapro1 on the glucose content of the hemolymph (Fig. 49) and glucose content lymph of hepatopancreas (Fig. 50) of H. fulvipes exposed to mercury and lead during different months of gestation. Fig

Dimercaprol along with mercury has reversed this effect by lowering the TNPS level (Table 40 Figs. 51 to 54).

The sublethal dose of lead on the contrary, depressed the TNPS content in the three tissues of maternal animal during the different months of the gestation period Administration of BAL together with sub lethal dose of lead tended to elevate the TNPS level, though insignificantly all in all maternal tissues indicating an antidotal effect (Table 40Figs51to54).

Table 42 (Table 42a, Table 42b and Table 42c) Levels of Aspartate Aminotransferase activity in Hepatopencreas, Pedipalpal Muscle and Embryo of H. Fulvipes treated with (a) Mercury (b) Mercury + Dimercaprol (c) Lead (d) Lead + Dimercaprol during different months of gestation N= 8

Table 42a	AAT µmoles of pyruvate formed/mg protein/hr Heapatopancreas			
Treatment	October	December	February	April
Control	0.82±0.02	0.97±0.03	1.02±0.02	0.97±0.04
Mercury	0.91±0.02^{C}	1.11±0.04^{C}	1.18±0.04^{C}	1.05±0.05^{b}
Hg + dimercaprol	0.82±0.02^{C}	0.96±0.03^{C}	1.01±0.03^{C}	0.96±0.04^{C}
Lead	0.94±0.03^{C}	1.19±0.04^{C}	1.22±0.04^{C}	1.12±0.04^{C}
Lead + dimercaprol	0.82±0.02^{C}	0.97±0.03^{C}	1.02±0.03^{C}	0.97±0.04^{C}

Table 42b	AAT µmoles of pyruvate formed/mg protein/hr Pedipalpal Muscle			
Treatment	October	December	February	April
Control	1.07±0.04	1.31±0.04	1.49±0.03	1.56±0.04
Mercury	1.15±0.05^{b}	1.51±0.02^{C}	1.76±0.02^{C}	1.86±0.02^{C}
Hg + dimercaprol	1.07±0.04^{b}	1.30±0.04^{C}	1.48±0.03^{C}	1.55±0.04^{C}
Lead	1.23±0.05^{C}	1.58±0.03^{C}	1.81±0.02^{C}	1.90±0.02^{C}
Lead + dimercaprol	1.08±0.04^{C}	1.30±0.04^{C}	1.48±0.03^{C}	1.55±0.04^{C}

Table 42c	AAT µmoles of pyruvate formed/mg protein/hr Embryo			
Treatment	October	December	February	April
Control	0.96±0.02	1.23±0.01	2.12±0.10	4.41±0.10
Mercury	1.02±0.03^{C}	1.32±0.02^{C}	2.25±0.09^{b}	4.74±0.21^{C}
Hg + dimercaprol	0.95±0.02^{C}	1.22±0.01^{C}	2.14±0.10^{b}	4.40±0.10^{C}
Lead	1.07±0.03^{C}	1.37±0.02^{C}	2.27±0.09^{b}	4.95±0.16^{C}
Lead + dimercaprol	0.95±0.02^{C}	1.22±0.01^{C}	2.14±0.10^{b}	4.40±0.10^{C}

b_p< 0.01; c_p< 0.001

Administration of sub lethal doses of mercury to the maternal animal during different stages of gestation elevated the TNPS level of the embryos similar to the response noticed in other maternal tissues. Lead on the contrary, had an opposite effect .Application of BAL along with the sublethal doses of heavy metals resulted in an antidotal effect in the embryos by reversing the effects of mercury and lead as was noticed in the maternal tissues (Table 40 Fig.51). Figs. 51, 52 53 and 54.

Table 43 (Table 43a, Table 43b and Table 43c) Levels of Alanine Aminotransferase Activity in Heapatopancreas, Pedipalpal Muscle and Embryo of H. Fulvipes treated with (a) Mercury (b) Mercury + Dimercaprol (c) Lead (d) Lead + Dimercaprol during different months of gestation N= 8

Table 43a	ALAT µmoles of pyruvate formed/mg protein/hr Heapatopancreas			
Treatment	October	December	February	April
Control	0.91±0.05	0.98±0.05	1.19±0.03	1.05±0.04
Mercury	0.84±0.02^{b}	0.88±0.02^{C}	1.04±0.03^{C}	0.97±0.04^{b}
Hg + dimercaprol	0.85±0.02*	0.89±0.02*	1.05±0.03*	0.99±0.04*
Lead	0.78±0.02^{C}	0.83±0.02^{C}	1.02±0.04^{C}	0.94±0.05^{C}
Lead + dimercaprol	0.79±0.02*	0.85±0.02*	1.03±0.04*	0.96±0.05*

Table 43b	ALAT µmoles of pyruvate formed/mg protein/hr Pedipalpal Muscle			
Treatment	October	December	February	April
Control	0.30±0.02	0.33±0.01	0.31±0.01	0.30±0.01
Mercury	0.27±0.01^{b}	0.28±0.01^{b}	0.26±0.01^{C}	0.25±0.01^{C}
Hg + dimercaprol	0.28±0.01*	0.30±0.01*	0.28±0.01*	0.26±0.01*
Lead	0.26±0.01^{C}	0.28±0.01^{C}	0.25±0.01^{C}	0.24±0.01^{C}
Lead + dimercaprol	0.27±0.01*	0.29±0.01*	0.26±0.01*	0.25±0.01*

Effect of dimercaprol on the TNPS content of the embryo (Fig. 51) pedipapa1 muscle (Fig. 52), hemolymph (Fig. 53) and hepatopancreas (Fig. 54) of H. fulvipes exposed to mercury and lead during different months of gestation.

Table 44 (Table 44a, Table 44b and Table 44c) Levels of Succinic Dehydrogenase Activity in Hepatopancreas, Pedipalpal Muscle and Embryo of H. Fulvipes Treated with (a) Mercury (b) Mercury + Dimercaprol (c) Lead (d) Lead + Dimercaprol during different months of gestation N= 8

Table 44a	SDH μmoles of pyruvate formed/mg protein/hr			
	Hepatopancreas			
Treatment	October	December	February	April
Control	0.49±0.01	0.42±0.01	0.41±0.01	0.37±0.01
Mercury	0.44 ± 0.01^{C}	0.40 ± 0.01^{C}	0.37 ± 0.01^{C}	0.35 ± 0.01^{C}
Hg + dimercaprol	0.45±0.01*	0.41±0.01*	0.38±0.01*	0.36±0.01*
Lead	0.42 ± 0.01^{C}	0.38 ± 0.01^{C}	0.34 ± 0.01^{C}	0.34 ± 0.01^{C}
Lead + dimercaprol	0.43±0.01*	0.39±0.01*	0.35±0.01*	0.34±0.01*

Table 44b	SDH μmoles of pyruvate formed/mg protein/hr			
	Pedipalpal Muscle			
Treatment	October	December	February	April
Control	0.30±0.01	0.33±0.01	0.31±0.01	0.25±0.01
Mercury	0.28 ± 0.01^{b}	0.31 ± 0.01^{C}	0.28 ± 0.01^{C}	0.23 ± 0.01^{C}
Hg + dimercaprol	0.29±0.01*	0.32±0.01*	0.29 ± 0.01^{C}	0.24 ± 0.01^{a}
Lead	0.26 ± 0.01^{C}	0.29 ± 0.01^{C}	0.27 ± 0.009^{C}	0.21 ± 0.01^{C}
Lead + dimercaprol	0.27±0.01*	0.30±0.01*	0.28±0.008*	0.22±0.01*

Table 44c	SDH μmoles of pyruvate formed/mg protein/hr			
	Embryo			
Treatment	October	December	February	April
Control	0.57±0.01	0.71±0.01	0.82±0.02	0.97±0.01
Mercury	0.55 ± 0.01^{a}	0.68 ± 0.01^{b}	0.80 ± 0.01^{a}	0.93 ± 0.01^{b}
Hg + dimercaprol	0.55±0.01*	0.69±0.01*	0.81±0.01*	0.94±0.01*
Lead	0.52 ± 0.01^{C}	0.65 ± 0.01^{C}	0.76 ± 0.01^{C}	0.90 ± 0.01^{C}
Lead + dimercaprol	0.54±0.01*	0.66±0.01*	0.77±0.01*	0.91±0.01*

$a_p< 0.05$; $b_p< 0.01$; $c_p< 0.001$; * insignificant

Effect of Dimercaprol on the protein content of maternal tissues and embryos of H fulvipes exposed to mercury and lead during gestation period.

The depressant effect of mercury and lead on the protein content of maternal tissues (hepatopancreas, haemo lymph and muscle) and embryos is clearly indicated in the Figs 55 to 58 and Table 39.

Estimation of proteins on the third day after the administration of BAL simultaneously with the heavy metals, showed no statistically significant effect in embryos and the materna1 tissues though indications for the detoxifying effect of the antidote do exist.

Effect of dimercapro1 on the lipid content of maternal tissues and the embryos Of H. fulvipes exposed to mercury and lead during gestation period.

When the maternal animal was exposed to sub lethal doses of mercury or lead the lipid content was depressed on the third day of administration in the hepatopancreas muscle, hemolymph and embryos. When the antidote, BAL was administered along with the sub lethal doses of heavy metals to the maternal animal, the anti- dote effect was indicated in all the tissues with the trends showing elevation of lipids, reversing the depressant action of the heavy metals (Table 41 Figs 59, 60, 61 and 62). Figs. 55, 56, 57 and 58

Effect of dimercaprol on the protein content of the embryo (Fig. 55) pedi pa pa l muscle (Fig. 56), hemolymph (Fig. 57) and hepatopancreas (Fig. 58) of H. fulvipes exposed to mercury and lead during different months of gestation.

Table 45 (Table 45a, Table 45b and Table 45c): Levels of Glutamate Dehydrogenase Activity in Hepatopancreas, Pedipalpal Muscle and Embryo of H. Fulvipes treated with (a) Mercury (b) Mercury + Dimercaprol (c) Lead (d) Lead + Dimercaprol during different months of gestation N= 8

Table 45a	GDH μmoles of pyruvate formed/mg protein/hr			
	Hepatopancreas			
Treatment	October	December	February	April
Control	0.17±0.01	0.25±0.01	0.19±0.007	0.17±0.007
Mercury	0.20 ± 0.01^{C}	0.29 ± 0.01^{C}	0.28 ± 0.01^{C}	0.22 ± 0.01^{C}
Hg + dimercaprol	0.16 ± 0.01^{C}	0.24 ± 0.01^{C}	0.23 ± 0.01^{C}	0.18 ± 0.01^{C}
Lead	0.21 ± 0.01^{C}	0.31 ± 0.01^{C}	0.30 ± 0.01^{C}	0.24 ± 0.01^{C}
Lead + dimercaprol	0.16 ± 0.008^{C}	0.25 ± 0.01^{C}	0.23 ± 0.01^{C}	0.19 ± 0.01^{C}

Table 45b	GDH μmoles of pyruvate formed/mg protein/hr			
	Pedipalpal Muscle			
Treatment	October	December	February	April
Control	0.20±0.01	0.24±0.01	0.17±0.01	0.17±0.01
Mercury	0.19 ± 0.01^{b}	0.22 ± 0.01^{a}	0.27 ± 0.01^{C}	0.19 ± 0.01^{b}
Hg + dimercaprol	0.16 ± 0.01^{C}	0.24 ± 0.01^{C}	0.23 ± 0.01^{C}	0.18 ± 0.01^{C}
Lead	0.21 ± 0.01^{C}	0.31 ± 0.01^{C}	0.30 ± 0.01^{C}	0.24 ± 0.01^{C}
Lead + dimercaprol	0.16 ± 0.008^{C}	0.25 ± 0.01^{C}	0.23 ± 0.01^{C}	0.19 ± 0.01^{C}

Table 45c	GDH μmoles of pyruvate formed/mg protein/hr			
	EMBRYO			
Treatment	October	December	February	April
Control	0.56±0.01	0.64±0.02	0.91±0.01	1.91±0.01
Mercury	0.58 ± 0.01^{b}	0.71 ± 0.02^{C}	0.95 ± 0.02^{C}	2.05 ± 0.03^{C}
Hg + dimercaprol	0.55 ± 0.01^{C}	0.64 ± 0.02^{C}	0.90 ± 0.01^{C}	1.89 ± 0.01^{C}
Lead	0.60 ± 0.01^{C}	0.74 ± 0.03^{C}	1.00 ± 0.03^{C}	2.10 ± 0.03^{C}
Lead + dimercaprol	0.55 ± 0.01^{C}	0.63 ± 0.02^{C}	0.91 ± 0.01^{C}	1.90 ± 0.01^{C}

$a_p< 0.05$; $b_p< 0.01$; $c_p< 0.001$;

Effect of dimercapro1 on the activity levels of AAT of materna1 tissues and the Embryos of H. fulvipes exposed to mercury and lead during gestation period.

The heavy metals, mercury and lead at the sub lethal doses administered to the gravid females in October, December, February and April during gestation, significantly elevated the levels of activity of aspartate aminotransferase in hepatopancreas and muscle of the maternal animal and the embryos Dimercaprol heavy metals administered with the (BAL) simultaneously, reversed the effects of both the metals exerting its antidotal influence and restored the control levels of the activity of the enzyme in the embryos and the maternal tissues (Table 42; Figs. 63 64 and 65 Figs. 59 60, 61 and 62

Effect of dimercaprol on the lipid content of the embryo (Fig. 59) haemo lymph (Fig. 60) pedi pal pal muscle (Fig. 61) and hepatopancreas (fig. 62) of H. fulvi pes exposed to mercury and lead during different months of gestation

Figs. 63, 64 and 65 Effect of dimercaprol on the activity Levels of aspartate amino transferase in the embryo (Fig. 63)Pedipalpal muscle (Fig. 64) And hepatopancreas (Fig. 65) of H. fulvipes exposed to mercury and lead during different months of gestation.

Effect of dimercaprol on the activity levels of ALAT of maternal tissues and the embryos of H. fulvipes exposed to mercury and lead during gestation period.

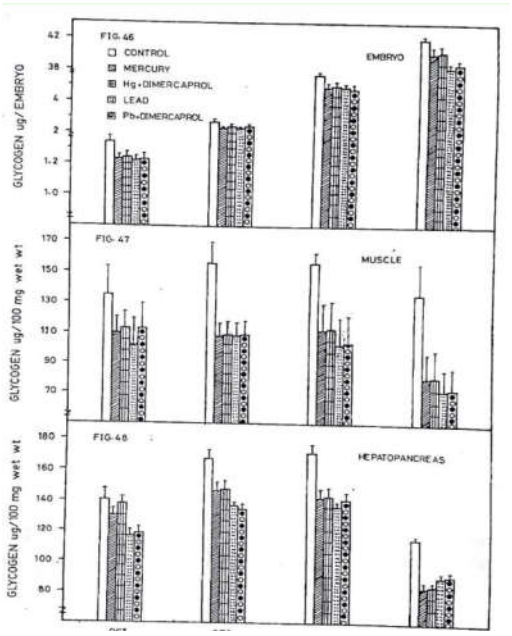

Figure 1

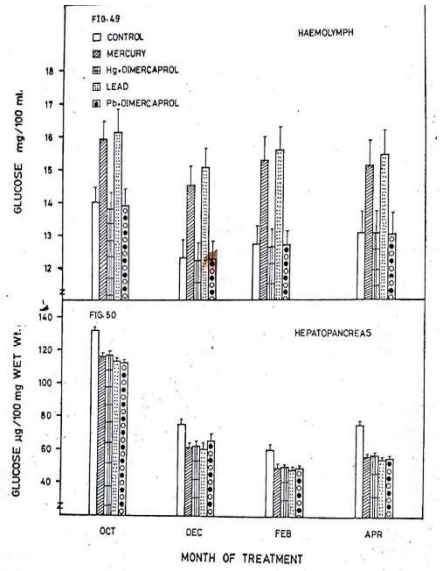

Figure 2

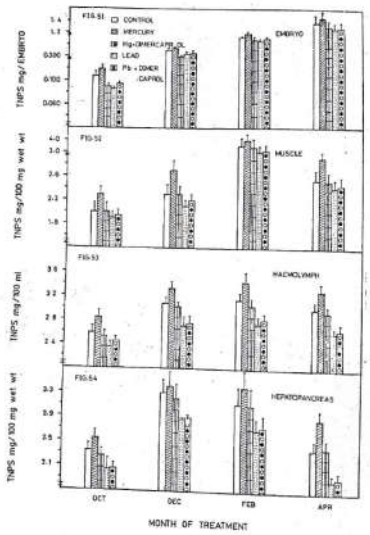

Figure 3

From a perusal of the Table 43 and Figs. 66 67 and 68 the depressant action of the sublethal doses of mercury and lead, administered at different times during the gestation period on the ALAT activity in embryos and the maternal muscle and hepatopancreas is obvious. Dimercaprol administered to the maternal animals treated with the heavy metals though did not exert a significant effect, slightly increased the activity levels of the enzyme in all the tissues indicating its antidota1 influence.

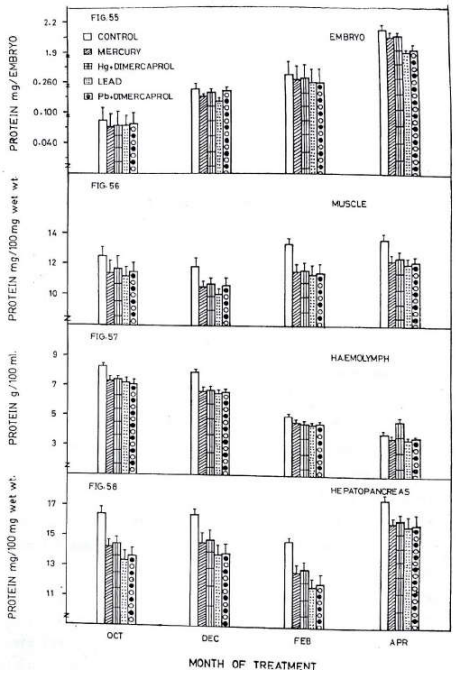

Figure 4

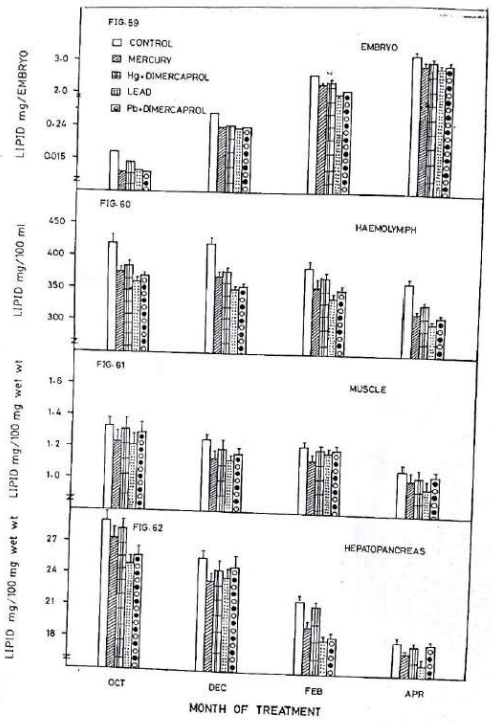

Figure 5

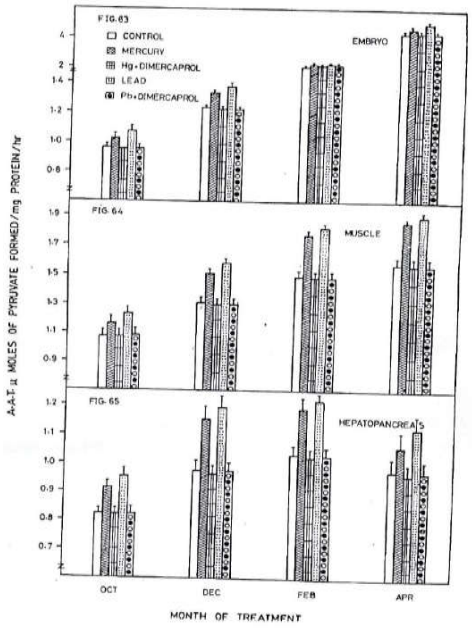

Figure 6

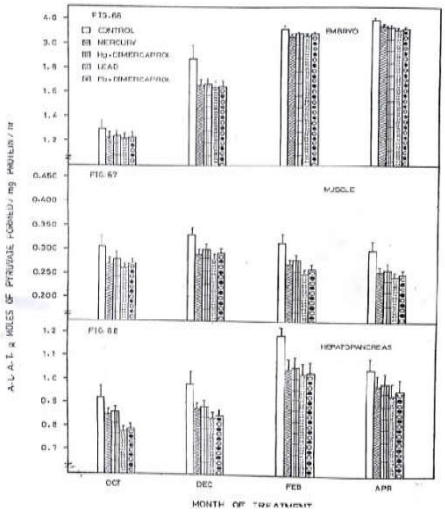

Figure 7

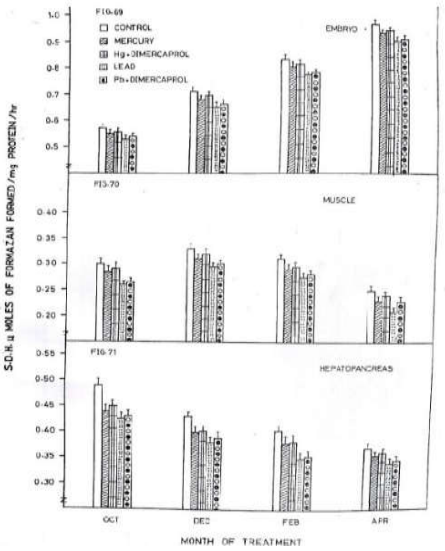

Figure 8

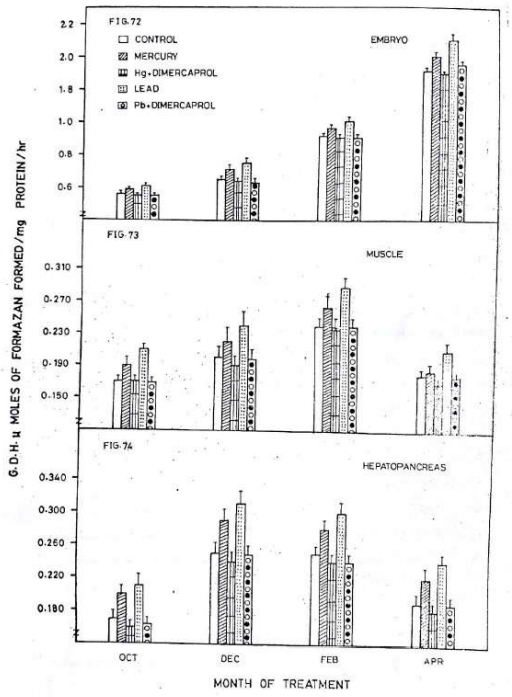

Figure 8

Effect of dimercaprol on the activity levels of SDH of maternal tissues and the embryos of H fulvipes exposed to mercury and lead during the gestation period.

The levels of activity of the succinic dehydrogenase are depressed in the embryos and maternal tissues (hepatopancreas and muscle) by the sub lethal doses of both mercury and lead. Dimercaprol slightly (statistically insignificant) increased the SDH activity Figs. 66, 67 and 68

Effect of Dimercaprol on the activity levels of alanine amino transferase in the embryo (Fig. 66) pedipalpal muscle (Fig. 67) and H. Fulvipes hepatopancreas (Fig. 68) of exposed to Mercury and lead during different months of gestation.

Levels in a cases, indicating a lowering of the effect exerted by the heavy metals in presence of the antitode, BAL (Table 44 Figs. 69 7o and 71.

Effect of Dimercaprol on the activity levels of GDH of Materna1 tissues and the embyros of H. fuivipes exposed to mercury and lead during the gestation period.

The heavy metals, mercury and lead at the sub lethal doses administered to the gravid females in October, December, February and April during gestation, significantly elevated the levels of activity of glutamate dehydrogenase in hepatopancreas and muscle of the maternal animal and the embryos. Dimercaprol (BAL) administered with the heavy metals significantly reversed the effects of both the metals exerting its antidotal influence and restored the control levels of the activity of the enzyme in the embryos and the maternal tissues (Table 45 Figs. 72 73 and 74). Fig. 69 7o and 71

Effect of dimercaprol on the activity levels of succinic dehydrogenase in the embryo i 69), pedipapal muscle (Fig. 70) and H. fulvipes hepatopancreas (Fig. 71) of exposed to mercury and lead during different months of gestation.

DISCUSSION

The results obtained in the present study reveal that both mercury and lead administered to the maternal anima1, H. fulvipes in sublethal doses bring about marked changes in the biochemical constituents in the different tissues of mother, and the embryos throughout the gestation period Glycogen, proteins and lipids were depressed in all the tissues by both the metals. TNPS was elevated only by mercury and not by lead. While these biochemical changes induced by lead and mercury could be viewed as a consequence of toxic manifestations of the heavy metals, reversal of these effects and restoration of control levels by any agents can be deemed an effective antidotal action. Dimercaprol, administered to the maternal animal along with the heavy metals brought about complete reversal,to the control levels, of glucose and TNPS, while the trends of recovery were indicated with reference to other constituents in other tissues thus exerting anantidotal action.

The toxic effects of heavy metals are known to be exerted by combining with one or more reactive groups essential for normal physiological function .Heavy metal antagonists compete with these groups for the metals and hereby prevent or reverse toxic effects and promote excretion of the metals (Klaassen, 1975). Pharmacological investigation revealed that dimercaprol (British anti lewisite) would provide protection against the toxic effects of heavy metals. Dimercaprol has been proved to be such more effective when given as soon as possible after exposure to metal (Kahn *et al*., 1977 Santana krishnan and Pushpa Bai 1978).

Dimercapro1, injected along with heavy metals in the present study exerted a clear cut effect by way of reversal of the toxic effects of the heavy uetals with reference to glucose and TNPS and indicated biochemical reversal with reference to other constituents both in maternal tissues and embryos. It could hence be suggested that dimercaprol can be used to revert the biochemical lesions induced by heavy metals and achieve safety not only to the maternal animal but also to the fetus during gestation period. sulfhy dry groups have a very high affinity for mercury lead and other heavy metals. Almost all proteins contain sulfhydryI groups that are meta1reactive. Hence, every protein in the body is a Potential target Heavy merals are thus potent but nonspecific enzyme poisons.

In the present study, the heavy metals, mercury and lead while inhibiting the activity of the enzymes, SDH and ALAT in maternal tissues and embryos. Elevated the levels of activity of GDH and AAT. The elevation of the activity of GDH and AAT, while appearing contradictory, Probably indicates a response to the special demands imposed by the stress condition Whatever the type of effect exerted by the heavy metals on the enzyme activity of maternal tissues and the embryos, dimercaprol has completely reversed the effects on the activity levels of GDH and AAT and indicated the reversal effect with reference to the other two enzymes. Hood and Pike, (1972) have shown that BAL subcutaneously injected into mice reduced the teratogenic action of simultaneous intra-peritonial injection of sodium arsenate. It is tempting here to suggest that dimercaprol can be used in conjuncture with heavy metal intoxication to avert the toxic manifestations induced by heavy metals at the biochemical and enzymatic levels, offering protection not only to the victim but also to the fetus during the gestation period.

References

1. Agarwal R, Goel SK, Chandra R, Behari JR. Role of vitamin E in preventing acute mercury toxicity in rat. *Environ ToxiconPharmacol*. 2010; 70-78. [PubMed]
2. Farina M, Brandão R, De Lara FS, Soares FA, Souza DO, Rocha JBT. Profile of nonprotiein thiols, lipid peroxidation and delta-aminolevulinate dehydratase activity in mouse kidney and liver in response to acute exposure to mercuric chloride and sodium selenite. *Toxicology*, 2003; 184:179-187. [PubMed]
3. Favero AM, Oliveira CS, Franciscato C, Oliveira VA, Pareira JSF, Bertoncheli CM, *et al*. Lactating and non-lactating rats differ to renal toxicity induces by mercuric chloride: the preventive effect of zinc chloride. *Cell BiochemFunct*. 2014; 32:420-428. [PubMed]
4. Franciscato C, Morales-Silva L, Duarte FA, Oliveira CS, Ineu RP, Flores EM, *et al*. Delayed biochemical changes induces by mercury intoxication are prevented by zinc pre-exposure, ecotoxicolSaf. 2011; 74:480-486. [PubMed]
5. Morales-Silva L, Bueno TM, Franciscato C, Oliveira CS, Peixoto NC, Pareira ME. Mercury chloride increases hepatic alanine aminotransaferase and glucose 6-phosphatase activities in newborn rats in vivo. *Cell Biol Int.* 2012; 36:561-566. [PubMed]
6. Oliveira VA, Oliveira CS, Ineu RP, Morales-Silva L, Siqueira LF, Pereira ME. Lactating and non-lactating rats differ in sensitivity to HgCl2: Pretective effect of ZnCl2. *J Trace Elem Med Biol*. 2014; 28:240-246. [PubMed]
7. Peixoto NC, Pereira ME. Effectiveness of ZnCl2 in protecting against nephrotoxicity induces by HgCl2 in newborn rats. *Ecotoxicol Environ Saf.* 2007; 66:441-446. [PubMed]
8. Rooney JP. The role of thiols, dithiols, nutritional factors and interacting ligands in the toxicology of mercury. *Toxicology*. 2007; 234:145-156. [PubMed]
9. He ZL, Yang XE, Stoffella PJ. Trace elements in agroecosystems and impacts on the environment. *J Trace Elem Med Biol*. 2005; 19 (2-3): 125-140. [PubMed]
10. Arruti A, Fernández-Olmo I, Irabien A, Evalution of the contribution of local sources to trace metals levels in urban PM2.5 and PM10 in the Cantabria region (Northern Spain) *J Environ Monit*. 2010;12 (7): 1451-1458. [PubMed]
11. Sträter E, Westbeld A, Klemm O. Pollution in coastal fog at Alto Patache, Northern Chile. *Environ SciPollut Res Int*. 2010 [Epub ahead of print] [PubMed]
12. Pacyna JM. Monitoring and assessment of metal contaminants in the air. In: Chang LW, Magos L. Suzuli T, editors. *Toxicology of Metals*. Boca Raton, FL: CRC Press; 1996. Pp. 9-28.
13. Wang Z, Rossman TG. In: The Toxicology of Metals, Cheng LW, editor Vol. 1. Boca Raton, FL: CRC Press; 1996. Pp. 221-243.

14. Chisholm,J.J.Jr and D.J Thomas-1985-Use of 2,3-Dimercaptopropane-1-sulfonate in the treatment of lead poisoning in children, *J.Pharmacol.Exp.Ther*.235:665-669.
15. Klassen,C.D. 1975-Bilary excretion of Mercury compounds.*Toxicol.Appl.Pharmacol*.33:356-365
16. Kahn, A., R.Denis and D.Blum-177 Accidental ingestion of Mercuric sulphate in a 4 -year old child. *Clinical Pediatrics* 16.No.10 956-958.
17. Santhanakrishnan B.R. and T. Pushpa Bai-1978, Lead poisoning in children in Madras city Indian pediatrics Volume xv no.6 ,449-472.
18. Hood,R.D, and C.T.Pike 1972-BAL alleviation of arsenate induced teratogenesis in mice. *Teratology*. 6:235-237.

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