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RESEARCH ARTICLE
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Hepatoprotective effect of *Curcuma longa* against lead induced toxicity in Wistar rats

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Abstract

Aim: The present investigation has been conducted to evaluate the hepatoprotective effect of *Curcuma longa* against lead induced toxicity.

Materials and Methods: For this study, 24 Wistar albino rats were taken. Control group (n=8), group – I rats (n=8) were given lead acetate @ 1000 mg/kg bodyweight (BW) and group – II rats (n=8) were treated with Curcuma longa @ 500 mg/kg BW along with lead acetate @ 1000 mg/kg BW (daily orally for 28 days). Serum biomarkers, oxidative stress parameters and lead concentration in liver were estimated.

Results: Oral administration of lead acetate for 28 days resulted in a significant increase in Aspartate amino transferase (AST), Alanine amino transferase (ALT), Alkaline phosphatase (ALP), significant increase of Lipid peroxidation (LPO) and decrease in Superoxide dismutase (SOD), Reduced glutathione (GSH) and increase in lead accumulation in liver. Treatment with *Curcuma longa* @ 500 mg/kg BW significantly ($P < 0.01$) decreased the elevated ALP, ($p < 0.05$) AST, ALT, LPO levels and increase in GSH levels and as compared to lead acetate treated group. But there was no significant difference in SOD level and lead concentration in liver when compared with lead acetate treated group.

Conclusions: The study concludes that supplementation of *Curcuma longa* @ 500 mg/kg daily oral for 28 days has shown protection against lead inducedhepatotoxicity.

Keywords: *Curcuma longa*, hepatotoxicity, lead, rats, serum biomarkers

Introduction

Liver is one of the vital organs of in vertebrates [1-2]. Hepatic injury leads to death of hepatocytes and can be identified when there is an increase of more than three times of normal serum transaminase enzymes [3]. Lead is one of the ubiquitous environmental pollutants and is naturally occurring bluish grey metal found in small amount in earth crust [4] and has continued to pose health hazards in animals and humans in many parts of the world [5]. The possible molecular mechanism involved in lead toxicity is oxidative stress, which is a consequence of an imbalance between oxidants and the antioxidant systems [6]. Heavy metals induce over production of reactive oxygen species (ROS) and consequently enhance lipid peroxidation, decrease the saturated fatty acids and increase the unsaturated fatty acid contents of membranes. In addition, ROS are highly reactive to membrane lipids, protein and DNA, and are believed to be the major contributing factors to stress injuries and lead to rapid cellular damage [7-12]. *Curcuma longa* is cultivated in India belonging to zingiberaecae family [13]. Curcumin, demethoxycurcumin and bisdemethoxycurcumin are the curcuminoids present in *Curcuma longa* [14]. Previously, it has been reported that *Curcuma longa* possesses antioxidant and hepatoprotective properties [15]. We have conducted this experiment to study the effect of *Curcuma longa* against lead induced toxicity.

Materials and Methods

Ethical approval: The protocol of the experiment was approved by the Institutional Animal Ethical Committee according to guidelines given by Committee for the Purpose of Control and Supervision of Experiments on Animals (CPCSEA).

Experimental animals: 24 wistar albino rats were taken and randomly divided in to three groups (n=8 each). They were housed in propylene cages under standard laboratory conditions with standard food and water ad-libitum. For this study, control group rats were given standard feed and deionised water. Group – I rats were given lead acetate @ 1000 mg/kg BW daily orally for 28 days, and group – II rats were treated with Curcuma longa @ 500 mg/kg BW along with lead acetate @ 1000 mg/kg BW daily orally for 28 days.

Chemicals: Lead acetate (Qualigens, Pvt. Ltd., Mumbai, India) was used as source of lead in this study.

Table-1. Effect of lead alone and with *Curcuma longa* on various parameters. (Mean ± SEM) (n=8).

Parameters	Control	Group - I	Group - II
ALT (IU/L)	38.74 ± 1.91	73.90 ± 1.76**	52.89±1.74^{a**}
AST (IU/L)	182.13 ± 4.11	225.18 ± 3.38**	199.29 ± 2.22^{a*}
ALP (IU/L)	119.97 ± 1.09	182.44 ± 6.24**	166.58 ± 7.38^{a*}
LPO (nM. MDA. g^{-1})	1.96 ± 0.2	4.11 ± 0.52**	3.90±0.32^{a*}
SOD (U/mg of protein)	4.48 ± 0.32	2.15 ± 0.14**	2.94 ± 0.14^{NS}
GSH (nM /g)	5.49±0.53	2.64±0.32**	4.86±0.61^{a*}
Lead (ppm)	0.08 ± 0.02	34.76 ± 2.54**	34.34 ± 2.36^{NS}

**P < 0.01; *P <0.05; statistically significant when compared to control group
^{a}**P <0.01; ^{a}* P <0.05; statistically significant when compared to group – I.
NS: statistically non-significant when compared with group – I.

Lead acetate powder was dissolved in distilled water and given orally to individual animals @ 1000 mg/kg body weight [16].

Plant material: *Curcuma longa* rhizomes were washed with distilled water, shade dried and powdered, and used along with acacia gum for oral administration @ 500 mg/kg BW [17].

Sample collection: Blood was collected from from the retro-orbital plexus and serum was separated by following standard procedure and was kept in refrigerator at 4^0C till analysis. Liver was collected after the sacrifice of the experimental animals and kept in -20 °c for estimation of oxidative stress parameters and lead concentration.

Biochemical estimation: Aspartate transaminase (AST), alanine-amino transferase (ALT) and alkaline phosphatase (ALP) in serum were analysed using Erba Semi-autoanalyzer by Erba-biochem kits.

Oxidative stress parameters: The pieces of liver collected after the sacrifice of the experimental animals were washed in ice cold saline and 200 mg of liver tissue sample was weighed and taken in 2 ml of ice-cold saline. For estimation of GSH (reduced glutathione), 200 mg of liver tissue sample was taken in 0.02 M EDTA. The homogenate was prepared in Remi - Homogeniser and was centrifuged at 3000 rpm for 10 min. The supernatant was used for estimation of following oxidative stress indices. Superoxide dismutase was estimated as described Madesh et al. [18]. The extent of lipid peroxidation was evaluated in terms of MDA production, determined by the thiobarbituric acid method [19]. The GSH level was determined by using DTNB method [20] in liver homogenate by using UV-VIS spectrophotometer (ECI, Hyderabad).

Lead concentration: Lead concentration was quantitatively analysed on day 29 in liver with the help of atomic absorption spectrophotometric analysis (AAS) [21]. Tissue was digested using acids and filtrate was prepared by using millipore water. Then final volume was made up to 10 ml with millipore water for reading on Varian AA240 model Atomic Absorption Spectrometer.

Statistical analysis: Quantitative data were analyzed, using the ANOVA. A value $P \leq 0.05$ and $P \leq 0.01$ were considered significant at 5% and 1%, level respectively.

Results and Discussion

Concentrations of biochemical variables are used to diagnose illness in domestic animals [22]. Elevated levels of serum enzymes observed are indicative of cellular leakage and loss of functional integrity of cell membrane in liver [23]. The present study shows the effect of lead on the body by considering various parameters like serum biomarker levels, oxidative stress parameters, and estimation of lead concentration in the body. In our results there was significant increase in ALT, ALP and AST levels in lead acetate treated group (Table-1) which was in accordance with the results reported previously [24-28]. Allouche et al. [29] reported no significant change in ALT & AST level after PbAc administration in male albino rats. Significant decrease in ALT, ALP and AST levels was found in group-II. The similar findings were observed by earlier researchers [30-31]. This may be due to hepatoprotective effect of *Curcuma longa.*

In the present study there was increased lipid peroxidation in liver of lead acetate treated group (Table-1). The results observed in this study were in correlation with the previous findings [32-33]. There was decreased SOD and GSH level in liver of lead acetate treated group (Table-1). The results obtained in this study were in agreement with the results of previous studies [34-36].

The decrease in level of lipid peroxidation and increased SOD levels in group-II might be due to potent antioxidant activity of *Curcuma longa* and similar findings were also reported by Sharma et al. [37]. A Significant increase in level of GSH was observed in group-II, in present study and the result was in agreement with Ahmod et al. [38]. In the present study there was significant increase in lead levels in liver and spleen in lead acetate treated group (Table-1). High concentration of lead was previously reported in liver of albino rats [39]. There was no significant difference in lead concentration of liver between group-I and group-II. Supplementation of a chelator along with *curcuma longa* could have protected the tissues from lead overload.

Conclusions

This study proves that exposure to lead for 28

days causes hepatotoxicity. The increase in the serum biomarker levels and lipid peroxidation indicate that the lead causes damage to liver, by damaging cellular integrity. Treatment with *Curcuma longa* showed protective effect.

Authors' contributions

SLB, RHG carried out the research work, sample analysis, drafting and revision of manuscript and statistical analysis. KP, NK contributed in sample collection and analysis. BKR, PHP helped us in discussion. All authors read and approved the final manuscript.

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Competing interests

The authors declare that they have no competing interests.

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