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Effects of Supplementation of Turmeric Extract on Balance Antioxidant-Prooxidant Spleen and Heart Tissues in Rats Exposed to Lead

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Abstract

***Background*:** One of today's environmental crisis that industrial technology it produces. Lead is one of the most important environmental contaminants that prolonged contact with the production of free radicals. Study results show that air pollution is increases mortality due to cardiovascular disease.

***Materials and Methods*:** To study the effects of consumption turmeric extracts on prooxidant- antioxidant balance of rats' spleen and heart tissues exposed to lead acetate. Thirty-six male rats randomly were classified into four groups as: 1) Basic, 2) Sham (turmeric solvent), 3) Lead, 4) turmeric extract+lead, (each group includes 9 rats). turmeric supplements were injected three times per week and total of 8 weeks to 30 mg/kg body weight. Injection protocol lead and turmeric extract or solvent (ethyl first) three sessions a week and will run for 8 weeks, all injections were in peritoneally.

***Results*:** After separation of spleen and heart tissues and homogenization, showed; injection of lead increases the index of lipid peroxidation in spleen and heart tissues. Also turmeric supplementation inhibits oxidative effects on the spleen and heart.

***Conclusion*:** Based on this research findings using a healthy style, and herbal supplements is effective in reducing the harmful effects anti-oxidation pollutants.

Introduction

In developing countries, disease patterns are shifting away from contagious diseases toward non-contagious diseases such as cardiovascular diseases, diabetes, high blood pressure, MS and cancer. Furthermore, recent studies have shown that such stressing factors are related to oxidative stress and inflammation [1]. According to results obtained by research, polluted air leads to higher fatalities due to cardiovascular diseases [2]. One of today's crises -which man regards as the result of industrial technology- is environmental pollution [1, 3]. Among air pollutants, lead is one of the heavy metals existing in various concentrations in the air, water and the soil; due to mechanized lifestyles and industrial activities, the diffusion of lead into the environment is on the rise as a result of the use of leaded fuels such as gas and industrial pollutions [4].

Studies have shown lead to be an environmental pollutant that can be toxic even at low levels; it brings about many harmful effects upon biochemical and physiological structures, and even causes behavioral disorders [5]. Lead is also long known to be involved in the toxification of body tissues with low antioxidative defenses, such as the heart [4]. Several researchers have reported that aging or exposure to polluted environments leads to increases in oxidative stress parameters in various tissues such as the heart and the liver [6, 7], and the brain [8, 9]. Moreover, studies indicate that the prooxidant-antioxidant status varies in different parts of the body [10, 11].

Some reports indicate that the heart has a lower antioxidative system compared to that of the liver and other tissues [11]. These findings show that the heart has a low antioxidative capacity which is sufficient in normal physiological conditions, whereas under stressing circumstances, such as exposure to polluted environments or old age, can lead to damage to the heart. Therefore, given the fact that heart attacks are the first cause of death in the world [12], and considering the undeniable effects of any form of environmental stress on the production of free radicals -and the consequent oxidative stress- on one hand, and some researchers' reports indicating the heart's low antioxidative defense levels compared to other tissues, such as the liver, on the other hand, researchers' studies in fields such as medicine and sports physiology have been devoting increasing attention throughout the recent decades has been devoted to the use of antioxidative substances or athletic activities. Therefore, researchers have spent the recent decades looking for strategies to control the harmful effects of lead on body

systems, in particular systems with weak antioxidative defenses. Research on the consumption of antioxidative supplements particularly of the herbal kind, due to their established effects on the body's antioxidative system has been of researchers' attention all over the world. In fact, it has been shown that turmeric extracts, known scientifically as Curcuma Longa, are poly-phenol compounds extracted from turmeric pigments and have anti-inflammatory and also antioxidative capabilities as well as preventing cell death [13]. Some studies have confirmed the antioxidative effects turmeric has by deactivating free radicals [14]. Furthermore, some researchers have reported that turmeric extracts are effective in treating inflammatory diseases such as cancer, diabetes, cardiovascular illnesses, arthritis and diseases of the nervous system [13, 15]. Hence, this research aims to study the effect of turmeric extract supplements on some indices related to the prooxidant-antioxidant status of the spleen and heart tissues in rats exposed to lead acetate.

Materials and Methods

The subjects for various groups in this research consisted of rats, which were affected by independent variables (receiving turmeric extract supplements and lead acetate) in a controlled media. In this research, having made the preliminary arrangements, 40 male, 3-month-old Wistar rats were acquired from the Pasteur Institute. Having been moved and accustomed to the laboratory environment, the rats were randomly divided into control (basic and sham), the treatment groups including turmeric extract and the lead group, with each group consisting of 9 rats.

The animals were kept in transparent, 30×15×15 cm polycarbonate cages manufactured by Razi Rad Company and at 20-24°C and 45-55% moisture and 12:12 light cycles. During the research period, animals were fed with 10 g of pellet-form food manufactured by Behparvar Company for each 100 g of the rats' body weight based on weekly weighing. The animals were also free to use water available from special bottles.

-Lead Acetate: To prepare this solution, two grams of lead acetate was weighed at an accuracy of 0.001 and placed in a graduated container; then, distilled water was gradually added to dilute the solution to 100 cubic centimeters. In this research, 20 mg of lead acetate solution for each kilogram of body mass was injected subcutaneously to the treatment groups 3 days a week for an 8-week period.

-The Turmeric Extract: To prepare this solution, one gram of turmeric extract (manufactured by the German company Sigma) was weighed on scales and placed in a graduated container. Then, one cubic centimeter of absolute alcohol was added, and the volume was subsequently increased to 100 cm^3 by using turmeric extract solvent (ethyl oleate). Furthermore, the turmeric extract was injected subcutaneously to the turmeric group in forms of a solution of ethyl oleate in 30-milligram doses for each kg of body mass 3 days a week through a period of 8 weeks. Considering the possible effects of turmeric extract on decreasing harmful impacts resulted by lead, a separate group -called the lead group- was also used in order to show the effects of lead upon prooxidant-antioxidant indices. As mentioned before, simultaneous to the injection of lead acetate to the sham group, 30 mg of turmeric extract solvent (ethyl oleate) was also injected for each kg of body mass 3 days a week through a period of 8 weeks. All groups were made unconscious and then killed by means of 5:2 solutions ketamine and xylazine in basic conditions 24 hours after the last injection of turmeric extract, lead acetate or solvent.

Then, spleen tissues and heart tissues were separated from the aorta root, immediately placed in liquid nitrogen, and then stored at -70°C. After homogenization and extraction, they were sent to the laboratory, where they were treated for the determination of prooxidant-antioxidant indices. Furthermore, spectrophotometric methods were used to measure lead levels [16].

Since the data distribution is normal -as shown by the Kolmogorov-Smirnov test- the one-way variance analysis (ANOVA) test was used to examine the changes in each of the prooxidant-antioxidant indices for the spleen and heart tissues for various groups. Furthermore, in case of significant statistical differences, the Tukey follow-up test was used at a $p \leq 0.05$ level. All statistical operations were carried out by means of SPSS-16 software.

Results

The subcutaneous injection of lead resulted in upsets in the prooxidant-antioxidant balances in spleen and heart tissues to prooxidants' advantage; nonetheless, the consumption of turmeric extract supplements caused the control of the prooxidants resulted by exposure toward lead and enhancements in the antioxidative defenses of the spleen and the heart.

Figures 1 to 4 display a summary of the findings of the research concerning the impacts of turmeric extract supplements on protein carbonyl (PC) and glutathione peroxidase (GPX) indices for four different study groups. As seen in figure1, the PC amounts -regarded as indices of oxidative stress in the spleen tissues of the group treated with lead- show increases of 56.43 (p=0.019) and 91.78% (p=0.002) compared to the sham and turmeric extract-lead groups; furthermore, the mean PC amounts for the subjects in the turmeric extract-lead group proves to have a 13.74% decrease compared to the sham group. All of the changes in the indices for spleen tissues compared to the lead group have 5% Alpha levels and significant p-value amounts; other groups, however, do not result in significant amounts compared to one another.

The data in figure 2 indicate that the mean GPX for the lead group shows 11.28 and 23.36 decreases compared to the sham and turmeric extract-lead groups respectively; also, a 15.76% increase is observed in the mean GPX for the subjects in the turmeric extract-lead group in comparison to the sham group. As seen in figure 3, compared to the sham and turmeric extract-lead groups, the PC for the heart tissues of the group treated with lead proves to have 68.70 and 97.87% increases (p=0.001);

furthermore, the mean heart PC for the subjects in the turmeric extract-lead group shows a decrease of 14.73% compared to the sham group.

Furthermore, as seen in figure 4, the heart GPX mean for the lead group compared to the sham and turmeric extract-lead groups shows 44.13 and 48.60% decreases (p=0.001); furthermore, the mean GPX for the subjects in the turmeric extract-lead group shows a 3.14% decrease compared to the sham group.

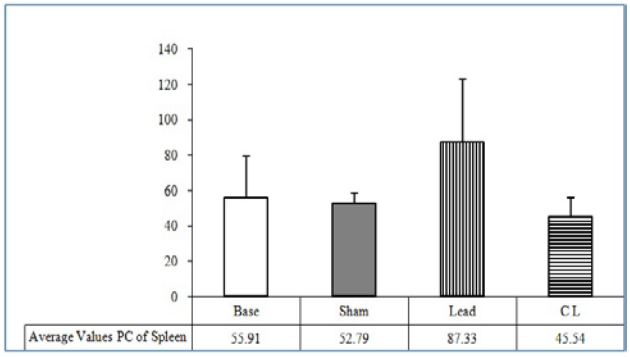

Figure 1. Effect of turmeric extract supplement on PC index in spleen of rats exposed to lead

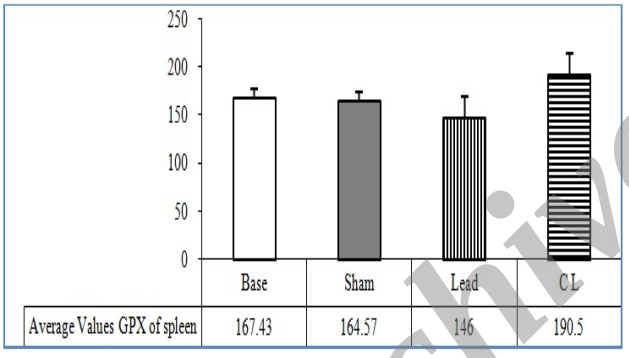

Figure 2. Effect of turmeric extract supplement on GPX index in spleen of rats exposed to lead

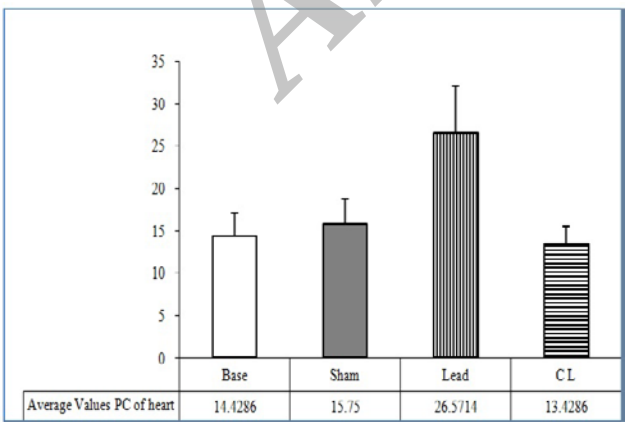

Figure 3. Effect of turmeric extract supplement on PC index in heart of rats exposed to lead

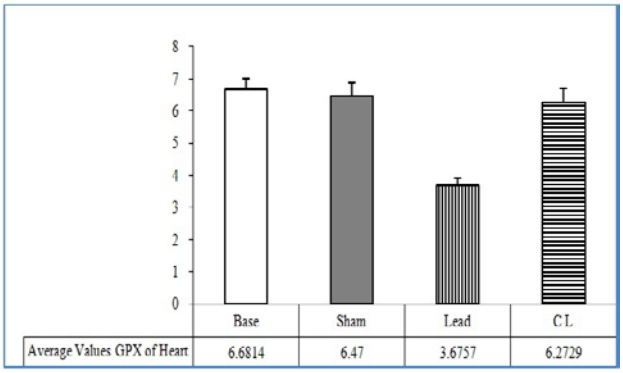

Figure 4. Effect of turmeric extract supplement on GPX index in heart of rats exposed to lead

Discussion

Polluted environments lead to diseases in various body systems, such as the cardiovascular system. The present research showed that continual exposure toward lead results in lipid peroxidation and reduced antioxidative capacities in spleen and heart tissues characterized with PC and GPX, respectively. Furthermore, chronic exposure toward pollution leads to imbalance in the oxidative and antioxidative processes in spleen and heart tissues.

Willis published the first report on oxidative stress caused by lead [17]. As other persistent toxic metals such as mercury, arsenic and cadmium, lead also damages cellular tissue and brings about changes in the genetics of cell tissue. There is increasing evidence that metals such as lead can, by generating reactive oxygen species, lead to lipid peroxidation, damage to the DNA and the discharge of the body's antioxidative defenses [4, 18]. Furthermore, researches show that the arousal of ROS by lead and the consequent discharge of the cell's antioxidative defenses may lead to disorders in the oxidative/antioxidative balance in tissues exposed to lead [5].

Research reports indicate lower enzyme antioxidative activities such as glutathione, peroxidase, superoxide dismutase, and catalase as well as higher heart inflammation or damage in subjects exposed to lead [4, 18, 19].

In brief, exposure to pollutants such as leads to the development of inflammation -probably by changing oxidative-antioxidative processes in the body- and, consequently, increased incidences of cardiovascular problems. The results of the present research indicated that the consumption of a supplementary turmeric extract brought about desirable changes in some prooxidant and antioxidant bio-indices in heart and spleen tissues. On the other hand, it was found that turmeric extracts can help fight the toxic effects of air pollution by enhancing anti-oxidative defense systems and neutralizing free radicals [20]. The findings resulted by the present research point out the necessity for avoiding exposure to polluted air or antioxidative nutrition as to confront oxidative factors. Moreover, a study of the effectiveness of other herbal anti-oxidative substances on other samples (such as older

people, pregnant women, diabetics, etc.) can be of researchers' attention for future studies.

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Authors' Contributions

All authors had equal role in design, work, statistical analysis and manuscript writing.

Conflict of Interest

The authors declare no conflict of interest.

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