

ANTIOXIDANT CAPACITY OF PIPERINE ON CYPERMETHRIN- INDUCED BRAIN TOXICITY IN RATS

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Abstract: The present study was undertaken to evaluate the protective effect of piperine against cypermethrin-induced toxicity in rats. The rats were divided into five groups of six each; the first group served as control and second group was used as vehicle control. While, groups III, IV and V were orally treated with piperine (50 mg/kg body weight), cypermethrin (25 mg/kg body weight) and cypermethrin plus piperine, respectively for 28 days. Cypermethrin administration caused elevated levels of lipid peroxidation in brain tissue. While the activities of antioxidants levels were decreased except superoxide dismutase. Administration of piperine along with cypermethrin significantly decreased the level of lipid peroxidation and significantly increased the catalase and glutathione peroxidase level. The results indicate that piperine ameliorate the cypermethrin-induced oxidative damage in rats.

Keywords: Piperine, Cypermethrin, Oxidative stress, Rat, Brain.

Introduction

Cypermethrin is a synthetic pyrethroid insecticide used worldwide in agriculture, home pest control, protection of foodstuff and disease vector control. It is highly hydrophobic compounds and this suggests that their action in biological membranes might be related to association with integral proteins and with phospholipids (Michelangeli et al., 1990). Several studies have shown that cypermethrin toxicity is linked to different mechanisms, including reactive oxygen species generation and oxidative stress (Kale et al., 1999; Gupta et al., 1999). Trends on applying plant products in diseases related to oxidative stress have gained immense interest in recent years. Plant products are known to exert their protective effects by scavenging free radicals and modulating antioxidant defence system. Piperine, a main component of *Piper longum* Linn, is a plant alkaloid with a long history of medicinal use in Indian medicine. The compound has many pharmacologic activities such as antioxidant, bioenhancer, anti-inflammatory and hepatoprotective effects (Selvendiran et al., 2004). Recently, we found that simultaneous supplementation of piperine along with cypermethrin lowered lipid peroxidation level and maintained superoxide dismutase, catalase, glutathione peroxidase and reduced glutathione levels to near those of control rats liver and kidney

(Sankar et al., 2011). Therefore, the present study has been undertaken to evaluate the ameliorating effect of piperine on cypermethrin-induced oxidative stress and alteration in antioxidant in brain of rats.

Materials and Methods

Animals were maintained under standard management conditions and handled as per the Institute Animal Ethics Guidelines. Rats were given standard rat feed and water ad libitum throughout the experiment. Rats were divided into five groups containing six animals each. Group I (control), was given normal saline, while Groups II was given once equivalent amount of ground nut oil (1%: Vehicle control). Group III was administered cypermethrin (25 mg/kg, orally) daily for 28 days. Group IV was administered piperine (50 mg/kg, orally) daily for 28 days. Group V was administered piperine (50 mg/kg, orally) and then cypermethrin (25 mg/kg, orally) daily for 28 days. Rats were sacrificed at the end of the exposure period. Brain was excised, washed with ice cold normal saline and used for the assay of oxidative stress and antioxidant related parameters. Estimations of different oxidative stress-related biochemical parameters in brain were carried out as per the standard protocol.

Results and Discussion

The changes in the LPO level and activities of GSH, GPx, SOD and CAT during exposure to cypermethrin and piperine in the present investigation were depicted in Table 1. In the present study, cypermethrin treatment induced a high degree of lipid peroxidation in the brain tissue of rats. Several studies have indicated that, there is increase in the intracellular levels of reactive oxygen species and oxidative stress in cypermethrin-induced toxicity (Giray et al., 2001). LPO has been shown to cause profound alterations in the structure and functions of the cell membrane, including decreased membrane fluidity and increased membrane permeability (Selvendiran and Sakthisekaran, 2004).

Antioxidant enzymes are considered to be the first line of cellular defense against oxidative damage. The decrease in the activities of GSH and GPx due to the generation of reactive oxygen species leads to enhancement in LPO. A significant reduction in GSH and GPx levels in liver and brain tissues and depletion of GSH and GPx in erythrocytes after dermal exposure of cypermethrin in rats have been reported (Raina et al., 2009). SOD is an antioxidant metalloenzyme that reduce superoxide radicals to water and molecular oxygen. The increase in SOD activity in brain of cypermethrin exposed rats may be due to the compensatory adaptive mechanism of the antioxidant system to combat the increased ROS

generation by the CYP toxicity. CAT is a haemoprotein, which reduces hydrogen peroxide to molecular oxygen and water. Reduction of CAT activity in cypermethrin treated rats may be due to the enhanced production of hydrogen peroxide. There is extensive evidence that supplementation of piperine can enhance antioxidant enzymes and other selenoproteins (Dhully et al., 1993). Oral supplementation of piperine increased the enzymatic antioxidants (catalase and glutathione peroxidase) levels to near those of control rats (Selvendiran et al., 2003). Simultaneous supplementation of black pepper or piperine in rats fed high fat diet lowered LPO and conjugated dienes levels and maintained SOD, CAT, GPx and GSH levels close to control rats (Vijayakumar et al., 2004).

In conclusion, the present study shows that piperine treatment mitigates cypermethrin-induced oxidative damage of rats, which could be due its antioxidant nature and free radical scavenging properties.

References

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Table 1: Effect of cypermethrin and piperine and their co-administration on oxidative stress parameters measured in brain of rats

	Control	Groundnut oil	Cypermethrin	Piperine	Cypermethrin+piperine
LPO (nmol MDA formed/g tissue)	20.95±0.53a	22.32±0.66a	71.72±1.07 ^a	21.61±0.73a	43.02±1.47 ^b
GSH (mmol GSH/g tissue)	0.16±0.01	0.14±0.01	0.07±0.01 ^a	0.14±0.01	0.11±0.01
SOD (Units/mg protein)	3.56±0.06	3.20±0.02	4.88±0.19 ^a	3.31±0.07	4.18±0.07 ^b
CAT (mmol H ₂ O ₂ utilized/min/mgprotein)	113.90±2.66	107.92±1.84	52.11±1.06 ^a	104.14±1.17	97.49±1.64 ^b
GPx (mol NADPH oxidized to NADP/min/mg/protein)	244.28±2.01	234.30±0.72	148.25±6.17 ^a	235.09±1.19	218.92±1.41 ^b

Values given represent the mean ± S.E of 6 animals. Significant differences are indicated by ^a compare to control, ^b compare to cypermethrin in a given row.