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Effects of L-cyhalothrin on the activity of Superoxide dismutase, Catalase in brain of Albino rats

Bonu. Narayana Rao* [1] & G. Simhachalam[1]

Department of Zoology and Aquaculture, Acharya Nagarjuna University, Guntur, A.P, India.

Abstract: The increase within the global's populace in the twentieth century could not were possible without a parallel growth in meals production. In the present study, the in vivo effects of L-cyhalothrin on the activity of Superoxide dismutase (SOD), Catalase (CAT+) exhibited tissue specific toxicity as well as dose dependent decrease in the activity. Albino rats are exposed to short-term sublethal and long-term acute doses through oral administration of Lambda Cyhalothrin (LCT) compound pyrethroids in the cerebral cortex, hippocampus, cerebellum and Pans medulla. The treated Albino rat showed a significant decrease in the activity of Superoxide dismutase (SOD), Catalase (CAT) in brain regions. Our results indicated that the brain was the main target organ for the insecticides, been unable to deal with pesticide toxicity leads to overproduction of free radicals during LCT toxicity may be associated with a decrease in overall antioxidant potential in the brain.

Keywords: Pyrethroids, Lambda Cyhalothrin, Superoxide dismutase, Catalase, Albino rat.

I Introduction

Pesticides are indispensable substances or mixtures of substances by farmers to control weeds and insects, and their remarkable increases in agricultural products (Sharma et al., 2019). The losses of crops caused by insect pests are quite high in both developing and developed countries (Dhaliwal, Jindal, & Mohindru, 2015). Reduced crop loss will be a key component, and enhanced pest management, including diseases and weeds, will require significant effort. The intensity of protection for crops, as shown by a 15-20-fold increase in pesticides used around the world, has increased significantly in order to make agriculture more productive and profitable (Savary et al., 2019). All types of pesticides are poisonous and extremely risky. Life without the usage of pesticides is not even remotely possible because of the benefits of pesticides. Misuse or unknowing use of pesticides and suicides through pesticide consumption is a common occurrence, particularly in developing countries such as India. People should be thoroughly educated about the benefits and high percentage risks of pesticides and the field of medicine should focus on the treatment of people, especially farmers who accidently consume pesticides through inhalation or orally.

LCT is a synthetic Type II pyrethroid insecticide and is commonly applied in rice fields to control insects. Potential water and sediment contamination may therefore, lead to toxicity in aquatic organisms such as fish, mosquito larvae, shrimps, clams and crabs. Albino rats are exposed to short-term sublethal and long-term acute doses through oral administration of lambda cyhalothrin (LCT) compound pyrethroids in the cerebral cortex, hippocampus, cerebellum and Pans medulla.

II Materials and Methods

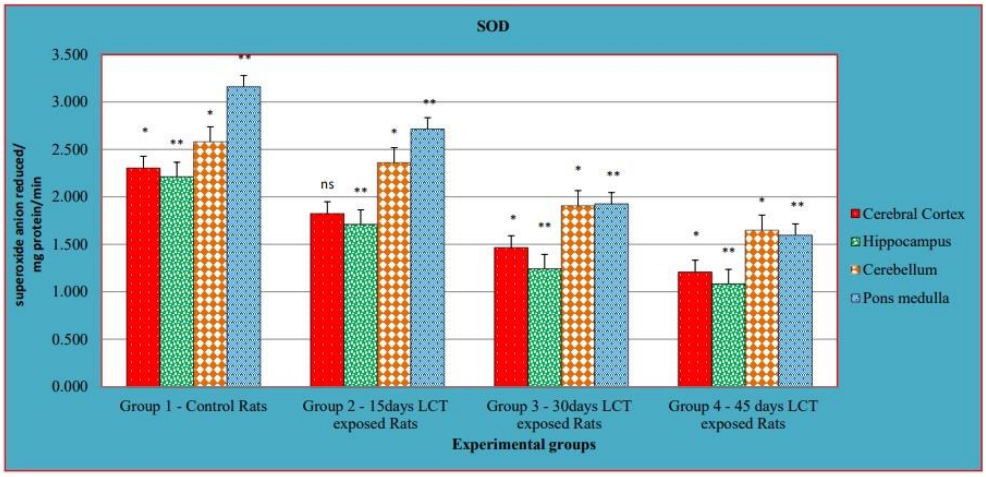
Superoxide dismutase activity was calculated at room temperature by the Misra and Fridovich (1971) process. Isolation of tissues from rats was done on the chosen test day, i.e. the 15th, 30th and 45th, were killed by cervical displacement for biochemical estimations. The brain was removed and placed on a cold glass dish right away. Different regions of rat brains, such as the Cerebral Cortex (CC), Hippocampus (HC), Cerebellum (CB) and Pons medulla (PM), were analysed for the enzyme assay, the optical density was calculated at 480 nm in the UV Spectrophotometer for 4 minutes.

Catalase activity was measured at room temperature by Aebi (1984) used to estimate in the regions of Rat brain such as Cerebral Cortex (CC), Hippocampus (HC), Cerebellum (CB) and Pons medulla (PM) were homogenized in an ice cold 50 mM phosphate buffer pH 7.0) containing 0.1 mM EDTA to obtain 5% homogenate (w/v). the optical density was calculated using the UV spectrophotometer at 240 nm for 60 s. For the determination of the activity of CAT, the molar extinction coefficient of 43.6 Mcm^{-1} was used. One unit of action is equivalent to the degraded H_20_2 mole / mg protein / min. The findings obtained have been statistically analysed.

III RESULTS AND DISCUSSION

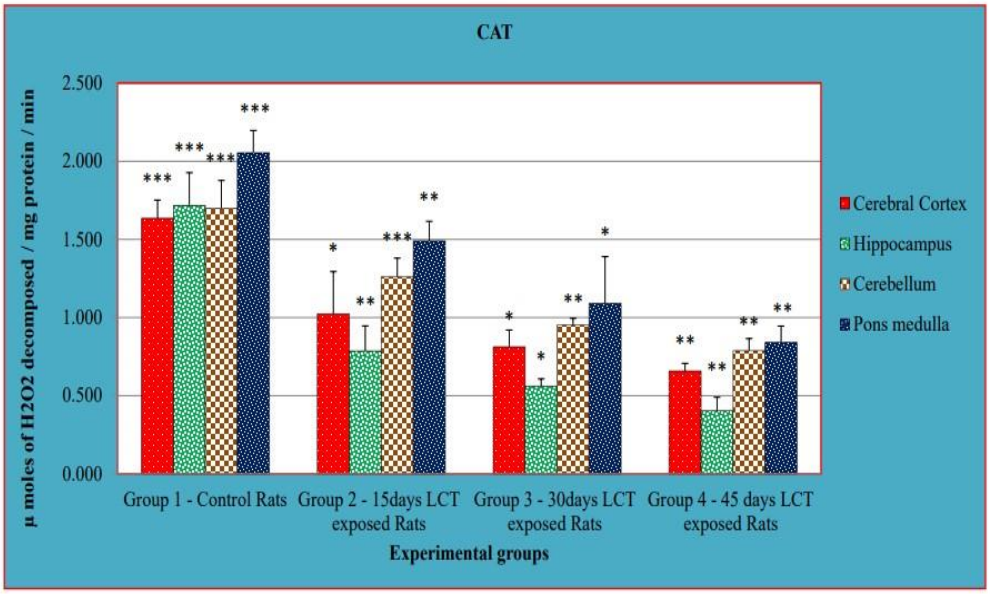
From the results obtained was clear that LCT exposed animals showed a decrement in the SOD activity in all the regions of the brain studied in the present investigation. Maximum decrement in the SOD activity was observed in the animals which were exposed to repeated doses for a longer period of time. The decrement in the SOD activity in different regions is as follows: The cerebral cortex of LCT exposed rat showed a maximum decrement of - 47.54% after 45 days. The % decrement in LCT exposed animals is as follows: 15 days (-20.80%) < 30 days (-36.35%) < 45 days (-47.54%). The decreases in the LCT exposed rats were found to be statistically significant in all the groups. When compare with all brain regions, hippocampus region of LCT exposed rat showed a maximum decrement and reached to -50.98% on 45day. The % decrement in LCT exposed animals is as follows: 15 days (-22.66%) < 30 days (-43.86%) < 45 days (-50.98%) The decrease in the SOD activity in LCT exposed animals showed statistically significant in all the groups. The decrease between 30 days and 45 days was not found to be significant through S-N-K test. The cerebellum of LCT exposed rat showed a maximum decrement of -36.06% on 45 day of experimentation. The percent change of decrement in LCT exposed animals is as follows: 15 days (-8.53%) < 30 days (-26.09%) < 45 days (-36.06%).

The decrease in the LCT exposed rat found to be statistically significant in all the groups. The decrease between 15 days and 30 days found to be significant through S-N-K test. The pons medulla of LCT exposed rats showed a decrement of -49.49% after 30 days and on 45th day. The % decrement in LCT exposed animals is as follows: 74 15 days (-14.07%) < 30 days (-39.05%) < 45 days (-49.49%) The decrease in the LCT exposed rat was found to be statistically significant in all the groups. The decrease between 30 days and 45 days was not found to be significant through S-N-K test.



Graphical representation of changes in Superoxide dismutase activity level (units of superoxide anion reduced/mg protein/min) in different regions of control and experimental rat brain exposed to LCT.

From the results it is clear that LCT exposed animals model showed decrement in the Catalase (CAT) activity in all the regions of the brain studied in the present study. Maximum decrement in the CAT activity was observed in the rats which were exposed to repeated doses for a longer period of time. The decrement in the CAT activity in different brain regions are as follows: The cerebral cortex of LCT exposed rats showed a maximum decrement of - 59.76% on 45 day of experimentation. The % decrement in LCT exposed animals is as follows: 15 days (-37.39%) < 30 days (-50.28%) < 45 days (-59.76%). The CAT activity was decrease in the LCT exposed rats found to be statistically significant in all the groups. The decrease between 30 days and 45 days was not found to be significant through S-N-K test. The hippocampus of LCT exposed rats showed a highest decrement of CAT activity -76.537% on 45 days. The % decrement in LCT exposed animals is as follows: 15 days (-54.25%) < 30 days (-67.33%) < 45 days (-76.53%) The decrease in the CAT activity in LCT exposed experimental rat was found to be statistically significant in all the groups. The decrease between 15 days and 30 days was not found to be significant through S-N-K test. The cerebellum of LCT exposed rats showed a maximum decrement of - 53.65% at end of the experiment i.e. on 45 day. The % decrement in LCT exposed animals is as follows: 15 days (-25.85%) < 30 days (-43.94%) < 45 days (-53.65%) The decrease in the LCT exposed rat was found to be statistically significant in all the groups. The decrease between 15 days and 30 days found to be significant through S-N-K test. 78 The pons medulla of LCT exposed rats showed a maximum decrement of - 59.08% during 45 day of experiment. The % decrement in LCT exposed animals is as follows: 15 days (-27.50%) < 30 days (-46.90%) < 45 days (-59.08%) The decrease in the LCT exposed rat was found to be statistically significant in all the groups. The decrease between 10 days and 20 days was not found to be significant through S-N-K test.



Graphical representation of changes in Catalase activity level (µ moles of H_2O_2 decomposed / mg protein / min) in different regions of control and Experimental rat brain exposed to LCT.

The antioxidant enzymes that provide the first line of cellular protection for ROS are SOD, CAT. There is a delicate balance, under normal physiological conditions, between the rate of development of hydrogen peroxide by dismutation of oxygen by SOD action. An antioxidant defence mechanism consisting of essential enzymes such as SOD, CAT is therefore regulated by the development of free radicals and tissue harm (Kamboj et al., 2006). Oxidative stress and cellular destruction result from the imbalance between cellular antioxidant enzymes. There is a high risk of oxidative damage to animals if the antioxidant mechanism is not capable of eliminating excess ROS (Uner et al., 2006; Oruc and Usta, 2007; Isik and Celik, 2008, Mansour SAK et al., 2017). The findings of the current study clearly show that oral administration of LCT in all regions of the brain of LCT-exposed animals, SOD, CAT showed a sharp decline.

Changes in SOD, CAT levels were found to be decreased in all brain regions in the current study, and this change was time-dependent and dose-dependent, suggesting that LCT causes experimental animals to suffer oxidative brain damage. In rats exposed to LCT in the liver and kidney, decreased antioxidant enzyme activity was observed (Fetoui et al., 2010 2009). They suggested that resolving the inflow of ROS caused by LCT exposure is a failure of the antioxidant system.

They also suggested that the toxicity of the LCT could be due to the release, under physiological conditions, of cyanohydrins that are unstable and further decompose into cyanides and aldehydes, which in turn, could serve as a source of free radicals. Intracellular antioxidant enzymes, such as SOD, CAT destroy ROS under physiological conditions and thus play an integral role in the protection of cell oxidative stress (Bukowska, 2004). The SOD is a significant enzyme in the detoxification process, and the improvement in the SOD suggests that superoxide radicals are caused by the LCT. From the study results it is clear that SOD showed a steady dose-dependent decrease, indicating that SOD was stimulated to protect animals from LCT stress by scavenging superoxide radicals. Similar studies of toxicity were carried out by Umakanthi et al., (2014). Sukanya and Doss (2013) and Rajendra Prasad (2007) Studies stated that a decreased activity in SOD and CAT in different brain regions of Albino rats exposed to Sublethal doses of Chlorpyrifos and Cypermethrin, respectively. The present study showed decrement levels in CAT activity in all regions of the brain exposed to LCT rats were in correlation with past studies. The ability of animals to react to toxicity from pesticides is based on the process of detoxification. By catalysing H_2O_2 into H_2O and O_2, CAT protects cells against the harmful effects of H_2O_2. An enzyme that transforms hydrogen peroxide to hydrogen and oxygen, CAT plays an antioxidant role and improves its function in oxidative stress-induced acute poisoning. The present study clearly shows that severe oxidative stress was subjected to the LCT exposed rat model. To mitigate the large volume of H_2O_2 resulting from a decrease in SOD operation, CAT is ideally suited. Studies of Olga Lopez et al., (2007); Box et al., (2007) indicated that CAT protects the animal from oxidative stress and increases the life of the animal reported that exposure to organophosphate pesticides in aquatic animals has resulted in a major decrement in CAT activity. In the present investigation, LCT compromised this ratio, indicating that the rats exposed to the pyrethroid were exposed to oxidative stress. The full amount of oxygen is needed by the brain and maximum energy is consumed. A poor antioxidant defence mechanism is present in the brain and this tissue is more vulnerable to oxidative damage compared to other tissues. Research studies of Rai et al., (2011) and Rai and Sharma, (2007) showed that Oxidative stress in the brain leads to increased oxygen demand and reduces the ATP/ADP ratio, possibly due to fluidity changes and inactivation of transmembrane enzymes, leading to neuronal membrane damage. Kamboj et al., 2006 reported that the roles of membrane bound glutamate and glucose transporters, Na^+ K^+ and Ca^{2+} ATPases, and ultimately cellular homeostasis, are seriously disrupted by pesticide-induced lipid peroxidation. Ahmed et al., 2013 and Ambali et al., 2012 studies showed that the effect of pesticides on the blood barrier and the quality of membrane lipids also appears to be altered by pesticide intoxication. Nagla Madkour (2012) reported that in the liver of LCT exposed rats, the antioxidant enzymes are altered. ROS production is associated with neurotransmitter synthesis may also account for variations in the brain's fatty acid composition, since myelin-rich white matter reduces polyunsaturated fatty acids than grey matter. The results of the present study indicated that increasing ROS production, LCT pesticide poisoning induces oxidative stress. By scavenging free radicals to maintain intracellular redox status, GSH plays a key role in regulating intracellular levels of ROS. By disrupting the metabolism of mitochondria, LCT appears to interfere with this key cellular pathway. Decreased levels of CAT, SOD, suggest that rats have been unable to deal with pesticide toxicity. In the current investigation, overproduction of free radicals during LCT toxicity may be associated with a decrease in overall antioxidant potential in the brain.

Conclusion: Enhanced pesticides i**n**tense and continuous usage utilization results in persistent levels, in the environment. Lambda-cyhalothrin, a type II synthetic pyrethroid has extensive uses in controlling a wide range of insects and pests of various crops, as well as in public health program. Due to high usage of lambda cyhalothrin, non-target organisms including mammals are extremely sensitive to its neurotoxic effects. As the soil half-life average 30days, so it is more potent toxic, For the prevention of the toxic effect of lambda-cyhalothrin, use of the drug in agriculture must be avoided. The food particles containing vitamin-C, E must be advised to take through diet.

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