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ENDOSULFAN TOXICITY ON SOME NEUROTRANSMITTERS IN THE BRAIN OF SWISS ALBINO RAT

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ABSTRACT

Among the pesticides used in agriculture, the organochlorine insecticide and acaricide endosulfan is still extensively used against pests in poor countries especially on crops such as tea, coffee, cotton and rice, The present study showed that repeated administration of endosulfan causes a marked alteration in the levels of dopamine and 5 HT receptors. The decrease in the dopamine receptor binding suggests disturbance in the dopaminergic system, due to endosulphan exposure, Dop amine system plays a significant role in the regulation of locomotor activity. The maximum number of binding sites for dopamine and an increase in serotonin receptor sites without any change in the binding affinity was observed after administration of endosulfan in albino rats .In the treated rats, a significant dose-dependent increase in the binding of [^{3}H]-5 HT in the frontal cortex was seen after 19 hours However, no such effect was observed after 5 hours of treatment and no significant changes were detected in GABA receptor binding following exposure to endosulfan. Monoamine oxidase activity was significantly decreased in animals exposed to a dose of 5 mg and 15 mg/kg body weight for 20 days.

KEYWORDS: Endosulphan, MAO and GDH.

INTRODUCTION

Endosulfan is considered as a highly toxic insecticide and has been classified among the Persistent Organic Pollutants. It affects the nervous system of a large range of organisms, including humans (EPA,} In mammals, endosulfan acts on the central nervous system by altering neurotransmission in the brain and by activating cholinergic, dopaminergic and serotonergic mechanisms.[1] Endosulfan also induces neurological disorders, hyperactivity, convulsions, paralysis and memory problems a broad-spectrum organochlorine insecticide and acaricide for control of agriculture pests on a variety of field, fruit, and vegetable crops. Endosulfan active ingredient is mixture of two isomers α and β, in the ratio of approximately 70% and 30% respectively. Endosulfan has been reported to cause central nervous system disorders in industrial workers and farmers. The individual and farmers exposed to high levels of Endosulfan are reported to exhib it epilepsy, hyperactivity irritability, tremors, convulsions and paralysis. Experimental studies show that it affects the levels of some neurotransmitters and their re ceptors.[2]

Major neurotransmitter receptors including acetylcholine (muscarinic), dopamine, serotonin (5HT) and GABA are known to transducer their signals to the cell interiors through the phosphoinositide derived messenger system.

Endosulfan residue has been identified in a variety of environmental media (air, surface water, ground water, soil and sediment) and its metabolites have been reported in human and domestic animals' milk[3] fruit and vegetable. The most likely way for people to be exposed to endo sulfan is eating the contaminated food with it. Exposure to endosulfan may occur by breathing, eating, or drinking the substance, or by skin contact.[8]

OBJECTIVE

The objective of this study was to investigate the effects of endosulfan effect on neurotransmitter.

METHODOLOGY

The procedure according to the ethics and guidelines. Albino male were used in this study. All the chemicals used were of guaranteed grade.

Treatment of Animals

Endosulfan administered orally with the help of cannula. Endosulfan (4mg and 16 mg/kg body weight) was administered for five hours and daily up to 19 hours. The control rats in an identical manner for both the groups.

Biochemical Procedure

Preparation of crude synaptic membrane and neurotransmitter receptor binding assay.

Determination of Glutamate Dehydrogenase Activity The enzyme activity was measured by method of Rajlaxmi et al.[9]

Protein Estimation by lowry method[10]
Determination of Monoamine Oxidase Activity was measured by the method of tabor et al.[11]

OBSERVATIONS

Table 1: Effect on Monoamine Oxidase (MAO) and Glutamate Dehydrogenase (GDH).

Treatment	Activity of striatal monoamine oxidase	Activity of cortical monoamine oxidase	Activity of Glutamate dehydrogenase
Control	1.55±0.15	1.98±0.39	17.9±0.5
4mg/kg b.w	0.47±0.09***	1.47±0.2	13.2±1.7
16 mg/kg b.w	0.62±0.11**	0.8±0.2*	15.1±0.7
Data are mean± S.E *p<0.05, **p<0.01, ***p<0.001			

RESULTS

The binding of spiperone was found to decrease in a dose dependent exposure to Endosulfan at a dose of 4mg and 16 mg/kg body weight. The decrease in the binding of [^{3}H]-spiperone was more pronounced, when the animals were exposed to 16mg/kg body weight Endosulfan, for 20 days.

A significant dose dependant increase in the binding of [^{3}H]-5 HT was observed in the frontal cortex after 18 hours. Howev- er, no such effect of the Endosulfan seen after 5 hours treat ment. Analysis [^{3}H] spiperone binding revealed that the decrease in the binding was due to the decrease in the maximum number of binding sites without any change in the affinity of the receptor. Similarly, the increase in the 5-HT binding was due to increase in the maximum num ber of 5-HT binding sites.[4]

No significant changes in the GABA receptors binding were observed.

In vitro studies showed that Endosulfan at concentration of 10-4 M and 10-5 M decreased the binding of [^{3}H] spiperone indicating a direct effect of Endosulfan on the rat dopamine e receptors levels; the decrease was significant at the 10-4 M concentration of Endosulfan. When studied at the concentrations ranging from 10-4 M to 10-5 M of Endosulfan, no such change was observed in the binding of [^{3}H]-5 HT. Monoamine oxidase activity was significantly decreased in the corpus striatum of the animals exposed to Endosulfan at a dose of 4mg and 16 mg/kg body weight for 20 days. The lower dose was found to have no such effect on frontal monoamine oxidase activity (Table 1).

DISCUSSION

The present observations show that repeated administration of Endosulfan causes a marked alteration in the levels of dopamine and 5 HT receptors. The decrease in dopamine receptor binding suggests disturbance in the dopaminergic system, due to exposure of Endosulfan.[2]

Dopamine system plays a significant role in the regulation of locomotor activity. The decrease in the number of binding sites of dopamine receptors in the brain was also observed which may be indicative of increased dopamine levels, since sensitivity of dopamine receptor is often modified by a change in the availability of neurotransmitter within the synapse. Exposure to Endosulfan leads to increase in the levels of serotonin receptors in the frontal cortex region of the brain.. Involvement of serotonergic system in the neurotoxicity induced by Endosulfan has been suggested by many investigators.[5] So normal dopamine functioning appears to be required for the establishment and maintenance of incentive learning in animals.[3]

It is significant to note that in comparison to other neu transmitters, dopamine receptors appeared to be more sensitive to Endosulfan. The dopamine receptors have been found to exhibit a greater sensitivity to neurotoxicants. The decrease in the binding of spiperone after exposure to Endosulfan seems to be a direct effect as con- firmed by in vitro studies, showing a significant alteration in the binding of [^{3}H] spiperone. There are several factors which could lead to the alterations in the neurotransmission of the nerve impulse including neurotransmitter synthesis, storage, release, interaction with receptors and termination of neurotransmitter action. Levels of brain monoamine neurotransmitters are however controlled by the availability of precursor amino acid or by the altered release of the transmitter from the presynaptic neuron or by the alteration in the activity of monoamine oxidase. Inhibition of monoamine oxidase activity has also been observed after endosulphan dose.[4]

Differences in the response in the monoamine oxidase activity of different brain regions in the presence of pesticides may be due to the specific nature of interaction between pesticide and membrane binding sites.

Involvement of muscarinic, cholinergic and serotonergic systems in the Endosulfan neurotoxicity has been observed in. Swiss albino rat after exposure to Endosulfan showed characteristic neuronal hyperactivity indicating increased cholinergic muscarinic stimulation and a significant increase in Glutamate dehydrogenase &

GABA.[7]

CONCLUSION

The present study showed that the decrease in the maxi mum number of binding sites of dopamine and increase in the serotonin receptors sites without any change in the alterations in the binding of DA and 5 HT receptors are suggestive of the disturbances in the neurotransmitter systems. The study showed that the dopamine receptors are more sensitive to endosulfan than other neurotransmitter receptors causing stress and effect on nervous system and memory.

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