

Organophosphorous Poisoning - A Plausible Herbal Antidote from the Dry Leaf Powder of *Sesbania grandiflora* L

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Abstract

Organophosphorus compounds (OPCs) are one of the major agrochemicals extensively used for crop protection and insect control worldwide. As the compounds are most toxic leading to increased poisoning especially among the spray persons severe restrictions and control measures of using them has been practised. There are a few antidotes developed exclusively for the poisoning of OPCs. With this status quo, an experimental pilot study was conducted to develop an herbal antidote for the OPC poisoning using the dry leaf powder extract of *Sesbania grandiflora* L. The leaves of the plant has already been proven to have many medicinal properties in terms of Indian System of Medicines, particularly its anticonvulsant, antiepileptic and anxiolytic activities in rodent models. Based on these scientific information a short term fourteen day pilot study was conducted where pesticide (Chlorphyriphos EC) exposed rodents were simultaneously treated with the leaf extract. At the end of the study, the analysis of brain samples of the treated and control groups for acetylcholine revealed a biologically significant sign of recovery among the treated animals in comparison with the control group. The levels of acetylcholine (AChE) in the herbal treated group of pesticide exposed animals remained comparable with the control group of animals, confirming the prospective antidotal potential of the leaf extract of *S. grandiflora* for the treatment of chronic OPC poisoning. This is hoped to serve particularly the agricultural people living in the remote rural areas where immediate health care and support systems are inaccessible in time.

Keywords: Organophosphorus Compounds (OPCs); *S. grandiflora*; Leaf

Introduction

The widespread use of organophosphorus compounds (OPCs) as one of the major crop protection measures in agriculture, and also in household insect control, is common and a proven method. Equally common is the incidence of poisoning among the spray-persons due to chronic occupational exposure on field as well as well as accidental acute and selfinflicted poisoning, especially in the developing countries [1,2]. The primary manifestations of organophosphorus poisoning is covalently

blocking of the cholinergic transmission by way of the inhibiting the acetylcholinesterase thereby causing respiratory paralysis and death. The symptoms majorly involve parasympathetic nervous system, affecting the neuromuscular junctions and central nerve synapses and to a lesser extent the cholinergic sympathetic systems [3].

Parathion (O,O-diethyl-O-p-nitrophenyl phosphorothioate) is the most toxic compound among the OP compounds and

physiologically human beings more vulnerable and therefore more sensitive to OP compounds than animals. Polyneuropathy is commonly observed especially among the OP spray-persons who occupationally get exposed to the OP compounds persistently, leading to the neuropathic conditions. As the primary cause of death is paralysis of the neuromuscular system Atropine and Pralidoxime are used clinically as antidotes. Treatment using oximes such as Pralidoxime iodide, which nucleophilically reacts with the AChE at the molecular level is also useful [4].

Interestingly, the OPCs are also therapeutically used for ophthalmic purposes such as chronic glaucoma and accommodative esotropia. Besides being used for treating neurological damages such as AD and Parkinson's diseases [5].

Methodology

The small tree plant *Sesbania grandiflora* L is a tropical plant present in South East Asian countries, supposedly originated from India. Its leaves are edible, having considerable medicinal values [6,7] and also serve as a good fodder crop for cattle. The leaves are used in the Indian Systems of Medicine for the treatment of epileptic seizures [8].

Through a bioassay guided separation of the leaves of *S. grandiflora* using benzene-ethyl acetate fractionation, an anticonvulsant triterpene compound was separated and tested for the convulsions of pentylenetetrazol (PTZ) and strychnine (STR)-induced seizures using mouse models. There found to be a shortened tonic hind leg extension in the maximum electroconvulsive shock (MES) proving the anticonvulsant action of the compound. Further it was found to inhibit the electrically induced seizures in mice and lithium-pilocarpine-induced status epilepticus in rats as well [9].

Results

Based on the review of the above scientific facts a short term pilot study was carried out using a rodent model, Wistar rats (*Rattus norvegicus*). The study involved a short term exposure of treatment, control and treated control groups of rodents of both the sexes for a period of two weeks. Feed and water were provided *ad libitum* throughout the study. An oral exposure at the dose of 5 mg per kg body weight of Chlorpyrifos (48% EC, M/s Gharda Chemicals, Mumbai) by oral intubation for a duration of fourteen days with a control group was conducted. Half of the pesticide

treated group was concomitantly administered with an oral intubation of 500 mg of dry leaf powder of *S. grandiflora* mixed with water. At the end of the study period all the animals of three groups were sacrificed humanely and the brain was collected for AChE levels were analysed based on the method of Ellman., *et al.* [10]. The results revealed a biologically significant sign of recovery among the treated animals (G3) in comparison with the control group whereas the pesticide alone treated group (G2) showed increased levels of AChE. The levels of AChE in the herbal treated group of pesticide exposed animals (G3) remained comparable with the control group of animals, confirming the prospective antidotal potential of the leaf extract of *S. grandiflora* for the treatment of chronic OPC poisoning (Refer Table 1).

Control, G1 (Distilled water)	Pesticide Treatment, G2 (Chlorpyrifos 48% EC, 5 mg/kg b.wt.)	Pesticide, Herbal combined Treatment, G3 (Chlorpyrifos 5 mg/ kg + Sesbania 500 mg/kg b.wt.)
1.273	2.895	1.51
3.01	1.158	3.01
1.852	2.316	1.85
1.737	1.737	1.74
1.389	2.316	1.15
1.85 ± 0.70	1.85 ± 0.69	2.08 ± 0.66

Table 1: Estimation Results of ChE Analysis, ($\mu\text{mol/g}$ tissue).

Key: mg/kg = Milligram/kilogram, b.wt = Body Weight, μmol = Micro Moles, g = Gram; Values are represented as Mean \pm S.D (n=5).

Note: There is no statistical significant when compared with control, $p > 0.05$. Initially the data set was checked for normality using Shapiro-Wilk test and homogeneity using Levene's test. As it followed normal distribution and assumed equal variance, One-way Analysis of Variance was used.

Discussion

The leaves of *S. grandiflora* has already been proved to have anticonvulsant activities that could be therapeutically used to as an antidote in treating the poisoning victims to OPCs. There is a need to confirm the correlation between the identified triterpenoid compound that was fragmented from the leaves in one of the above

referred study with the OP pesticide exposed animal models. If the proposed study is favourable then it is going to be a great support especially to the rural areas of the economically lagging countries where immediate first aid and poisoning treatments are remote and inaccessible.

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