

## *Withania somnifera* (L.) Dunal ameliorates imidacloprid induced neurotoxicity: Inhibition of oxidative stress, apoptosis and downregulation of glial fibrillary acidic protein in female Wistar rats

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In agricultural farming, neonicotinoid insecticides are used to control insect pests on agricultural crops and ectoparasitic arthropods on animals. Here, we evaluated the oral toxicity of one of the commonly used neonicotinoid insecticides, imidacloprid (IMI) on the brain tissue of female Wistar rats and its amelioration by Indian ginseng, *Withania somnifera* (L.) Dunal. The study was conducted on a total of 48 female Wistar rats divided into four groups, each containing 12 rats. Gr. I was normal control; Gr. II, imidacloprid; Gr. III, *W. somnifera*; and Gr. IV with both imidacloprid and *W. somnifera*. The rats were subjected to oral treatment of *W. somnifera* (1 g/kg feed) for a period of 30 days to measure the protective effect against neurotoxicity induced by imidacloprid (30 mg/kg body wt./day). Six rats from each group were sacrificed on 16<sup>th</sup> and 31<sup>st</sup> day. The results showed that imidacloprid significantly decreased the reduced glutathione, super oxide dismutase and increased the thio barbituric acid reactive substance (TBARS) levels. It also caused histopathological, immunohistochemical and ultrastructural changes in the brain. Whereas, *W. somnifera* significantly increased the reduced glutathione, super oxide dismutase (SOD) and reduced the TBARS levels. Further, it inhibited apoptosis by upregulation of B-cell lymphoma 2 protein and reduced the neuronal degeneration by downregulation of glial fibrillary acidic protein. These results indicate that *Withania somnifera* may be beneficial in ameliorating the imidacloprid induced oxidative stress and apoptosis in the brain tissue of rats.

**Keywords:** Ashwagandha, B-cell lymphoma 2, Brain, Glial fibrillary acidic protein (GFAP) expression, Imidacloprid, Indian ginseng, Neonicotinoids, Neuroprotective, Winter cherry