

Effect of Acute Inhalation Exposure to Propisochlor on Rats

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Abstract

Propisochlor is a widely used herbicidal active ingredient for protecting crops against weeds. During its production and application, however, this compound is present in the air of the working zone and the ambient atmosphere and exerts adverse effects on the health of workers and the general population. Given the limited data on toxic effects following chronic inhalation exposure and the use of this active ingredient in technological processes at production sites within the Russian Federation, a more thorough investigation of the hazard of propisochlor upon repeated inhalation exposure is necessary to minimize the health risk on human. The aim of the present study was to conduct experimental work to establish the threshold of acute action of propisochlor upon inhalation exposure, with a view to subsequently selecting concentration levels for a chronic experiment. The experiments were carried out on 58 outbred male laboratory rats ($n = 29/\text{group}$) weighing 160–180 g. Inhalation exposure was modelled using a head-nose inhalation system (TSE Systems, Germany). The animals were exposed to a respirable aerosol fraction of propisochlor at a concentration of $4569 \pm 392 \text{ mg/m}^3$ for 4 hours. Changes after exposure were assessed with a battery of hematological, biochemical, ethological, and functional tests in comparison with the day before exposure and with control-group rats. To evaluate ethological parameters in the open-field test and the hole-poke test, a neural network model based on Deeplabcut was used. An increase in respiratory rate was detected in the experimental group on day 1 after exposure compared with control animals ($p = 0.043$). Serum biochemical parameters were most markedly altered at 2 hours after exposure. The following changes were observed: a decrease in creatinine ($p < 0.001$), urea ($p = 0.001$), and α -amylase ($p = 0.004$); an increase in uric acid ($p < 0.001$), total bilirubin ($p < 0.001$), and AST ($p = 0.034$). By day 1 after exposure, the creatinine level had returned to the control group level, and a decrease in ALT was also found ($p = 0.023$). On day 3 after exposure, the ALT level was increased ($p = 0.023$) relative to the control group and relative to the ALT level on day 1 after exposure ($p = 0.0026$). By day 14 after exposure, all biochemical parameters in the experimental group had returned to control levels. It was established that propisochlor at a concentration of $4569 \pm 392 \text{ mg/m}^3$ exerts toxic effects on the excretory and digestive systems as well as on the respiratory organs. All changes were transient in nature; therefore, the above-mentioned concentration is taken as the threshold concentration.

Keywords

Propisochlor, Inhalation Toxicity, Herbicides, Pesticides, Threshold of Acute Action