Safety Evaluation of Geraniol Through Three Different Routes of Administration: Acute Toxicity Profile Following Single and 14-Day Repeated Dosing in Rats

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ABSTRACT

Introduction: Geraniol is a naturally occurring monoterpenoid alcohol widely found in essential oils of aromatic plants such as roses and lemongrass. It is extensively utilized in the fragrance, flavor, and cosmetic industries due to its pleasant floral aroma. Beyond its commercial applications, geraniol has garnered scientific interest for its therapeutic potential, including neuroprotective, anti-inflammatory, anticanceric, antioxidant, and anxiolytic properties (Nisar *et al*., 2022a) (Nisar *et al*., 2024) (Zhang *et al*., 2021) (Alasmari *et al*., 2022) (Atef *et al*., 2022), underscoring its relevance in pharmaceutical and biomedical research.

Objective: Safety profile was evaluated by conducting 24 h and 14 d acute toxicity studies through oral, intraperitoneal, and intranasal routes of administration.

Methodology: In acute toxicity, 24 h after the administration of geraniol orally, (p.o., 2500 mg/g and 5000 mg/kg), intraperitoneally (i.p., 100 mg/kg), and intranasally (i.n., 100 mg/kg) did not cause any mortality while deaths were recorded at the i.p. dose of 850 mg/kg (33% mortality), 950 mg/kg (50%), and 1000 mg/kg (100%). In another acute toxicity study, repeated administration of geraniol for 14 d at various doses, showed zero percent mortality. Hematological, biochemical, and hepato-histological alterations were found in geraniol administered rats through p.o. and i.p. routes. These hepto-toxicological effects of geraniol are predicted due to upregulation of CYP2E1 in liver (Valdés-Tresanco *et al*., 2020).

Result: There was a non-significant difference between the histology of brain, lungs, heart, and kidney tissues in both studies. Thus the present study determined that the LD_{50} of geraniol is 950 mg/kg (i.p.) and found to be safe up to the dose of 100 mg/kg through i.n. and i.p. routes following 24 h of administration. While in 14 d acute toxicity study, it was safe up to 50 mg/kg (i.n.), 150 mg/kg (i.p.), and 400 mg/kg (p.o.).

Conclusion: This study provides a toxicity profile of geraniol having pharmacological and commercial importance and gives information regarding safety use through three different routes of administration.

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