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Menthol as an alternative anaesthetic and sedative for trout, *Oncorhynchus mykiss*

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Fish have a neuroendocrine system that is highly sensitive to nociceptive stimuli and stressful conditions. As a result, ethical considerations necessitate the use of anaesthetic agents to ameliorate suffering. Menthol is well-known for its analgesic properties, but little information is available on its potential as an anaesthetic on fish. The purpose of this study was to assess anaesthetic effectiveness of menthol and its safety on rainbow trout (Oncorhynchus mykiss). Juvenile trout (180±28 g) were exposed to concentrations of 10-150 mg/l menthol in water and observed for physiological responses, induction time and recovery times. Menthol concentrations of 40-150 mg/l induced anaesthesia, albeit after varying exposure times. There was an exponential relationship ($p<0.001$) between induction time and menthol concentration. Menthol concentrations of 80-150 mg/l induced anaesthesia within three minutes of exposure and fish recovered within five minutes. Induction and recovery data showed that 80 mg/l was most suitable for anaesthesia. Concentrations of 10-20 mg/l had sedative effects. Menthol stock solutions prepared using ethanol and acetone and storage of stock solutions at room temperature up to 48 hours had no significant differences in anaesthetic response. When exposure duration was kept constant at three minutes, 22% of fish had temporary cessation of gill ventilation and such fish had longer recovery times. No observable health effects were noted within 72 hours post-exposure. The results show that menthol is an effective anaesthetic for trout. However more studies on biochemical responses of exposed fish are recommended.

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