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*Assessment of different stunning methods and recovery of farmed Atlantic salmon (*Salmo salar*): isoeugenol, nitrogen and three levels of carbon dioxide*

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Abstract

*Isoeugenol (17 mg L^{-1}), nitrogen, and three levels of carbon dioxide (low: 70–80, medium: 180–250 and high: > 400 mg CO_2 L^{-1}) were tested as stunning agents for Atlantic salmon (*Salmo salar*) fasted for six days. All methods were tested under optimised conditions (starting with rested fish, and stunning and recovery under good water quality conditions). The fish were assessed in relation to behaviour and stress in terms of blood chemistry and muscle biochemistry. Only isoeugenol fulfilled all of our set criteria related to fish welfare and stress as it: (i) minimised aversive reactions upon exposure and ability to render the fish unconscious; (ii) showed no recovery during a period of 10 min post stunning; and (iii) achieved minimal muscle activity (good muscle quality). The fish treated with nitrogen showed the strongest aversive reactions, produced the most stressed fish, and fish that did not appear to be sedated. Nitrogen stunning cannot therefore be recommended. None of the levels of carbon dioxide fulfilled all criteria. When exposed to high and medium levels, fish exhibited aversive reactions and became considerably stressed. At the low level, changes in behaviour and stress were modest, but in such cases the fish were not sufficiently immobilised to facilitate easy handling in a possible pre-stunning context. No level of carbon dioxide rendered the fish unconscious. Even under optimised stunning conditions, the use of carbon dioxide cannot be recommended in connection with slaughter of Atlantic salmon.*

Keywords: *animal welfare, recovery, rested harvest, salmon, stress, stunning*