

EFFECTS OF EXERCISE AND TEMPERATURE ON GEOSMIN EXCRETION BY EUROPEAN EEL (*Anguilla anguilla*) AND ATLANTIC SALMON (*Salmo salar*)

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Introduction

The presence of geosmin in fish products causes an earthy or musty off-flavour. To avoid economic damage resulting from market entrance of off-flavoured fish products, fish farmers utilize the reversibility of geosmin bio concentration to deplete the off flavours from their fish crops by holding them in clean water just before harvest. To improve this process, effects of exercise and temperature on the excretion of geosmin by European eel (*Anguilla anguilla*) were assessed.

Materials and methods

European eels with a mean (SD) weight of 152 (14) g, a mean (SD) lipid content of 33.1 (2.1) % and loaded with geosmin were depurated for 23h during which they were subjected to combinations of exercise (spontaneous swimming activity at 0.05 m s⁻¹ or forced swimming at optimal swimming speed of 0.55 m s⁻¹) and temperature (15°C or 25°C) treatments. 127L Blazka-type swim tunnels (Van de Thillart et al. 2004) set up in temperature controlled rooms were used as experimental units. Oxygen consumption (MO₂ in mg O₂ kg⁻¹ h⁻¹) was measured during the depuration tests. Whole body geosmin concentrations were measured in samples collected at t=0 and t=23h to assess geosmin excretion and calculate geosmin excretion rate constants k₂ (Howgate, 2004).

Results and Discussion

Geosmin excretion by European eel was clearly enhanced by exercise, but temperature had no significant effect. Exercise increased oxygen consumption, which in turn showed a positive linear relation with geosmin excretion (Fig. 1). These findings support the idea that the physiological adaptations aimed at increasing oxygen uptake also affect the branchial exchange of lipophilic xenobiotic chemicals between the fish and its surroundings (e.g. Brinkmann et al., 2014; Blewett et al., 2013; Yang et al., 2000). The excretion of various other lipophilic chemicals has previously been positively related to oxygen consumption in other fish species (Yang et al., 2000). We therefore consider it highly likely that the here observed effect of exercise during depuration is not limited to geosmin and European eel but may also enhance the excretion of 2-methylisoborneol, the other chemical that causes off-flavour in fish, and be effective in other fish species.

We used the observed geosmin excretion rate constants to explore preliminary the practical implications of our current findings for off-flavour depuration. It then appears that depurating off-flavours from European eel in warm water and under forced exercise may reduce the required depuration time by up to 60% as compared to commonly practiced depuration in cold water without forced exercise.

Conclusion

Exercise can be used to reduce the time required to depurate geosmin from European eel. These findings are relevant for aquaculture industries confronted with off-flavoured fish crops. A similar experiment has already been executed investigating the effects of exercise for 24 and 48 h on geosmin and 2-methylisoborneol excretion in Atlantic salmon.

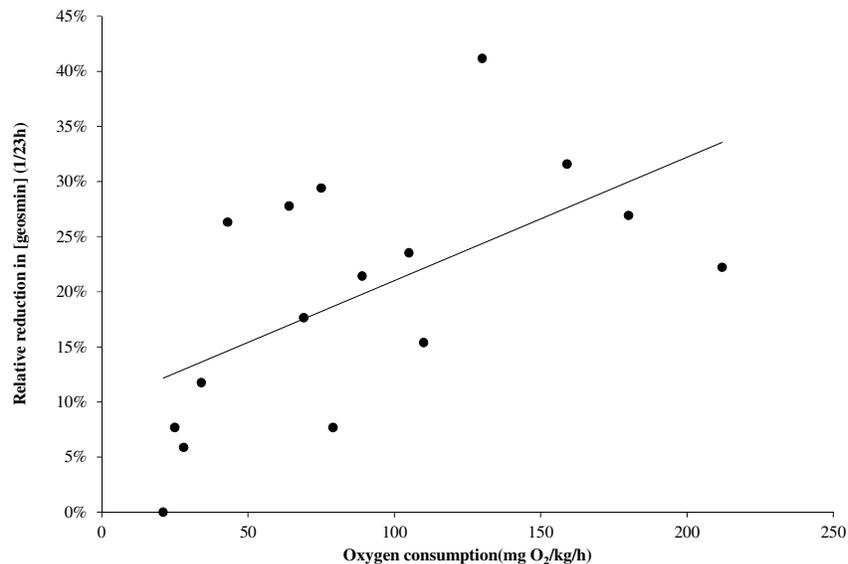


Fig. 1 Geosmin excretion by European eel (expressed as the relative decline of the whole body geosmin concentration over 23h, Δ geosmin (%)) in relation to its oxygen consumption (MO_2). Δ geosmin (%) = $9.8 (4.4) + 0.112(0.04) * MO_2$ (linear regression analysis, $p = 0.02$, $r^2 = 0.29$, SE for parameter estimates in parentheses).

Literature

- Blewett, T.A., Robertson, L.M., MacLatchy, D.L., Wood, C., 2013. Impact of environmental oxygen, exercise, salinity and metabolic rate on the uptake and tissue-specific distribution of 17α -ethynylestradiol in the euryhaline teleost *Fundulus heteroclitus*. *Aquatic toxicology* 138-139, 43-51.
- Howgate, P., 2004. Tainting of farmed fish by geosmin and 2-methyl-iso-borneol: a review of sensory aspects and of uptake/depuration. *Aquaculture* 234, 155-181.
- Van den Thillart, G., van Ginneken, V., Körner, F., Heijmans, R., Van Der Linden, R., Gluvers, A., 2004. Endurance swimming of European eel. *Journal of Fish Biology* 65, 312-318.
- Yang, R., Brauner, C., Thurston, V., Neuman, J., Randall, D.J., 2000. Relationships between toxicant transfer kinetic processes and fish oxygen consumption. *Aquatic toxicology* 48, 95-108.