## ABSTRACT

Oxidative damage during embryogenesis affects muscle development in the goldfish, *Carassius auratus*

Yamin Ogilvie

Muscle development and growth were investigated in goldfish, *Carassius auratus*, which were exposed to oxidative stress during embryogenesis. Embryos were incubated in solutions of 0, 15, 30 and 45 nM hydrogen peroxide ($H_2O_2$) from the 64 – 128-cell stage until hatching. After hatching the fish were reared in $H_2O_2$-free water for 21 d. There was an inverse relationship ($P < 0.005$) between the $H_2O_2$ concentration at which embryos were held and the standard lengths (SL) at hatching. There was no effect on the total cross-sectional area of fish but there was a decrease in the number fibres at higher $H_2O_2$ levels and an increase in mean fibre cross-sectional area ($P < 0.001$). The results suggest that embryonic exposure to oxidative stress adversely affects subsequent somatic and muscle growth by reducing the ratio of hyperplastic to hypertrophic processes in later developmental stages, indicating that the ratio of muscle fibre hyperplasia to hypertrophy is directly related to the growth rate.

$H_2O_2$ exposure at 45 nM during embryogenesis increased cell proliferation rate (i.e., it increased the incorporation of bromodeoxyuridine into nuclear DNA) immediately post-hatching. There was an increase in the antioxidant superoxide dismutase (SOD) in all $H_2O_2$-exposed groups compared to the $H_2O_2$-free group. This compensatory adjustment to oxidative stress could explain why there was no detectable oxidative DNA damage at any level of $H_2O_2$ exposure. Telomere lengths decreased in $H_2O_2$-exposed fish compared to $H_2O_2$-free fish but there

were no differences in telomerase activity. This suggests that the observed reduction in hyperplasia in $H_2O_2$-treated animals may have been preceded by a period of accelerated, pre-hatching cell proliferation in the $H_2O_2$-exposed fish, and may be followed by a period of rebound, depressed proliferation post-hatching.

**Keywords**

*Carassius auratus*, hydrogen peroxide, hyperplasia, hypertrophy, cell proliferation rate, superoxide dismutase activity, oxidative DNA damage, telomere length, telomerase activity