

THE EFFECT OF EXOGENOUS EMBRYONIC ANTIOXIDANT EXPOSURE ON
POST-HATCH GROWTH AND DEVELOPMENT IN THE ZEBRAFISH,
BRACHYDANIO RERIO

A Thesis

Submitted in Fulfilment of the Requirement for the Degree of
Doctor of Philosophy in Zoology

of

The University of the West Indies

by

Sheena Francis

2006

Department of Life Sciences
Faculty of Pure and Applied Sciences
Mona Campus

i

**THE EFFECT OF EXOGENOUS, EMBRYONIC ANTIOXIDANT EXPOSURE ON
POST-HATCH GROWTH AND DEVELOPMENT IN THE ZEBRAFISH,
*BRACHYDANIO RERIO***

ABSTRACT

Sheena Francis

Zebrafish (*Brachydanio rerio*) embryos were exposed to low concentrations of the antioxidants lipoic acid (0 – 15 μM) and vitamin C (0 – 200 μM), and post-hatch growth and development was monitored. The antioxidants increased ($P < 0.05$) standard lengths of the larval fish at hatching and up to 15 d post-hatching without affecting the yolk sac area of the animals. While embryonic antioxidant exposure had no effect ($P > 0.05$) on the total cross-sectional area of the muscle fibres in the region immediately behind the anuses of newly-hatched fish, exposing embryos to 10 μM lipoic acid and 100 μM vitamin C increased ($P < 0.0005$) the number of muscle fibres that newly-hatched fish possessed in that region. The percentage of small fibres (i.e., those with cross-sectional areas $\leq 30 \mu\text{m}^2$) just behind the anus was also greater in 10 μM lipoic acid-incubated fish and in 100 μM vitamin C-treated fish than in their control counterparts ($P < 0.01$). The levels of basic fibroblast growth factor (FGF2) in newly-hatched fish that were incubated, as embryos, in 12 μM lipoic acid and in 100 μM vitamin C were greater than those in control fish ($P < 0.001$). Within 1 week of hatching, though, the situation had reversed, with 7 d-old, antioxidant-treated fish having lower FGF2 levels than their control counterparts ($P < 0.0005$). Embryonic antioxidant exposure had no effect on insulin-like growth factor-1 levels in fish ($P > 0.50$). At hatching, the rates of 5'-bromo-2-deoxyuridine (BrdU) incorporation into DNA (an index of nuclear proliferation rates) were greater ($P < 0.0005$) in antioxidant-exposed fish than in control ones. However, the rates of BrdU incorporation in 3 d-old, antioxidant-treated fish were lower ($P < 0.005$) than those in control fish of identical age. Telomere lengths and telomerase activities at hatching were both lower ($P < 0.005$) in antioxidant-treated fish than in fish from the control group. Embryonic antioxidant exposure had no effect ($P > 0.05$) on the amount of 7,8-dihydro-8-oxo-guanine (an indicator of oxidative DNA damage) in fish at hatching. The activities of the endogenous antioxidant enzyme superoxide dismutase were greater ($P < 0.001$), however, in both 0 d- and 7 d-old, antioxidant-treated fish than in their control counterparts of corresponding age. These results suggest that, in the zebrafish, antioxidant treatment during embryogenesis enhances internal variables that lead to increased muscle hyperplasia and somatic growth in the larval stages.

Keywords

Brachydanio rerio, embryos, antioxidant, lipoic acid, vitamin C, muscle development, hyperplasia, hypertrophy, growth factor, telomere length, telomerase.