The effects of arsenic on the two major fibre types in the chelae of the freshwater crayfish *Cherax destructor* (Clarke)

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Arsenic is a proven carcinogen found in the soil in gold mining regions at concentrations that can be thousands of times greater than gold. During mining arsenic is released into the environment, easily entering surrounding water bodies. The main chemical forms of arsenic found in the environment are arsenite (As(III)) and arsenate (As(V)), which are known to be the more toxic and available arsenic compounds.

It has been found that *Cherax destructor* (the yabby) can accumulate arsenic at levels comparable to those in the sediment of their environment (Williams *et al.*, 2008).

This study determined the effects of arsenic contamination on the yabbies themselves. Individual muscle fibres with long- or short-sarcomeres from the chelae of the yabbies were used to determine if arsenic exposure altered muscle function e.g. Ca^{2+} sensitivity and Ca^{2+}-activated force production. Yabbies were exposed to arsenic at 10 ppm Sodium Arsenite, $AsNaO_2$ (5.7 ppm As(III)) and 10 ppm Arsenic Acid, $Na_2HAsO_4{\cdot}7H_2O$ (2.6 ppm As(V)) for 40-60 days. After exposure either their left or right chela was removed and cut open to expose the muscle fibres. Individual muscle fibres were dissected from the chela and "skinned" (membrane removed) before being attached to the force recording apparatus. Muscle fibres were then placed in solutions of increasing $[Ca^{2+}]$ until a maximum Ca^{2+}-activation was obtained (pCa 4.47). Various parameters (e.g. pCa_{50} the $[Ca^{2+}]$ required to produce 50% of the maximum. Ca^{2+}-activated force) were derived from these activation profiles to determine the effect of arsenic on Ca^{2+} sensitivity and maximum Ca^{2+}-activated force.

Exposure to As(III) produced a small yet significant leftward shift in the Ca^{2+}-activation curve of both long- and short-sarcomere fibres. As(V) exposure however, caused a more substantial leftward shift in the Ca^{2+}-activation curve (by 0.64 pCa units). These results indicate the muscle fibres have become more sensitive to Ca^{2+} after long term exposure to As(V) and As(III). Single fibres from the chela of As(V) exposed animals produced significantly more force (N/cm^2) (65.91 ± 11.66 Long-sarcomere; 25.73 ± 2.607 Short-sarcomere fibres) than muscle fibres from control animals (30.88 ± 3.34 Long-sarcomere; 14.73 ± 2.52 Short-sarcomere fibres).

Histological examination of the muscle fibres from the chelae of the yabby showed no alterations to the appearance of the muscles at a light microscopy level. Therefore it appears that the difference in Ca^{2+} sensitivity seen in the muscle fibres from arsenic exposed animals is a result of alterations at a molecular level. It has been shown that Ca^{2+} sensitivity in muscle fibres can be increased in the presence of amino acids (Powney *et al.*, 2003). Therefore an explanation for this altered sensitivity of the muscle fibres exposed to arsenic could be a change in the activity of the amino acid transporters in the muscle which may alter intracellular amino acid concentrations. Alternatively arsenic exposure may affect the binding affinity of troponin C (the Ca^{2+} binding subunit) to Ca^{2+} thus altering the sensitivity of the muscle fibres to Ca^{2+}. Thus, long-term exposure of the animals to arsenic alters the activation profiles of these two major fibre types in the chelae.

Powney EL, West JM, Stephenson DG & Dooley PC (2003) *Journal of Muscle Research & Cell Motility* **24:** 461-469.

Williams G, West JM & Snow ET (2008) *Environmental Toxicology & Chemistry* **27:** 1332-1342.