The testosterone metabolism of *Neomysis integer*: how different are we from shrimp?

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Alteration of the hormone system through chemicals (endocrine disrupters) has recently become a widely investigated and politically charged issue. Invertebrates account for 95% of the known species of animals on earth, yet surprisingly little effort has been put into understanding their value in signaling potential environmental endocrine disruption. Several indications however exist that chemical pollutants act as endocrine disruptors also in invertebrates.

Both vertebrate and invertebrate species use enzymatic biotransformations for the detoxication and elimination of xenobiotics. Testosterone has been used as a substrate to study the multiplicity of these enzymes. Since many of these enzymes are under hormone control, disruption of the hormone function can lead to potential effects on enzyme function and subsequently steroid homeostasis. The testosterone metabolism has therefore been proposed as a biomarker of exposure to endocrine disrupters.

In the present study, the estuarine crustacean *Neomysis integer* (Crustacea, Mysidacea) was exposed to both testosterone and [^{14}C]-testosterone. Identification and quantification of testosterone metabolites and endogenous vertebrate-type steroids was performed using TLC (Thin Layer Chromatography) and HPLC (High Pressure Liquid Chromatography) methods.

N. integer metabolises testosterone extensively: at least 11 mono-hydroxy metabolites, androstenedione and ß-boldenone (an anabolic steroid, known from veterinary drug preparations and also popular among bodybuilders, was identified for the first time in invertebrates) were detected and quantified. Evidence of a sex-specific metabolisation of testosterone was observed in *N. integer*. Endogenous vertebrate-type steroids were also identified in unexposed organisms and testosterone production was detected for the first time in mysid shrimp.

These new insights show an enzymatic biotransformation ability and steroid metabolism in mysid shrimp that rivals that of vertebrate species. This similarity of enzymatic biotransformation among species underlines the importance of further research on the steroid metabolism in invertebrates and the possible use of these systems as biomarkers for exposure to endocrine disrupters. These results stimulate further research on the use of invertebrates as relevant test species for the effects of endocrine disrupters and could result in the development of predictive biomarkers for detection of endocrine disruption in estuarine environments.

Keywords: testosterone metabolism; *Neomysis integer*; endocrine disruption; invertebrate.