

Ontogenetic changes in the expression of digestive enzymes in the European lobster, *Homarus gammarus*

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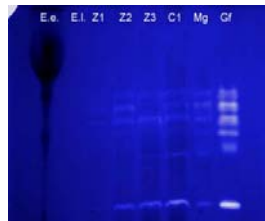
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Clawed lobsters (like *H. gammarus*) express unique digestive enzymes which differ from those of many other decapod species. These are e.g. high activities of cathepsin L and extreme low levels of trypsin and chymotrypsin in the gastric fluid. In order to investigate whether these physiological peculiarities appear throughout ontogenesis, a set of important digestive enzymes were analysed in early and late eggs (E.e. and E.l.), three larval stages (Zoea, Z1-Z3) and postlarvae (Crab1, C1) of *H. gammarus*. The results were compared with the activities in the midgut gland (Mg) and the gastric fluid (Gf) of adult specimens.

Zymograms

Total protease (pH 3)



Cathepsin L

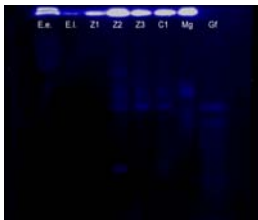


The zymogram of total protease showed up to five medium-sized bands and one smaller band. While the activities of the medium-sized bands in larvae, postlarvae and midgut gland were low, the activity was higher in the gastric fluid.

The zymogram of cathepsin L showed similar patterns of bands in larvae, postlarvae and the gastric fluid. This indicates that the activity of cathepsin L corresponds with the total proteolytic activity at pH 3.

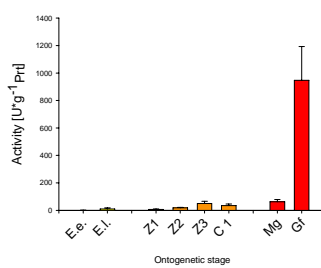
Lipase/Esterase

Throughout all ontogenetic stages and also in the midgut gland high activities of membrane bound lipases and esterases were present (top of the gel). Weaker activity bands of soluble lipases and esterases appeared from Zoea 2 on.

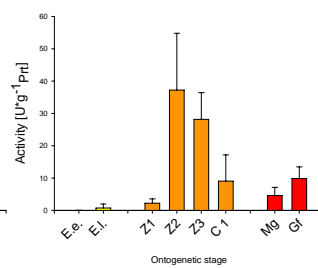


Enzyme activities

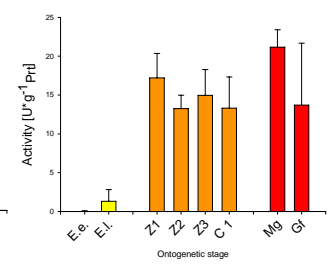
Cathepsin L



Chymotrypsin



Trypsin

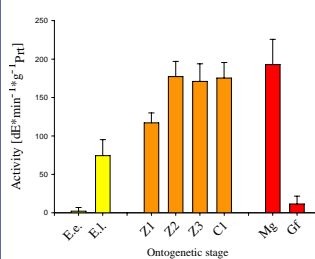


The activity of cathepsin L increased slowly in the larval stages but it predominated the gastric fluid of the adults. All ontogenetic stages showed low activities of the otherwise widely occurring serine endopeptidases trypsin and chymotrypsin (regard the scaling). While trypsin activity was constantly low throughout all larval stages and adults, the activities of chymotrypsin increased from Zoea 1 to Zoea 2 considerably but decreased continuously in the subsequent stages.

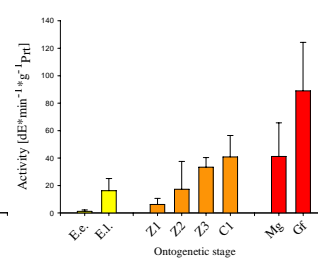
Phosphatase

The midgut gland is rich in acid phosphatases. In contrast, alkaline phosphatase dominated in the midgut gland. The ontogenetic stages showed high activities of acid but low activities of alkaline phosphatases. The zymogram of alkaline phosphatase showed one strong band in the gastric fluid.

pH 3



pH 10



CONCLUSIONS

Some important enzymes change significantly during larval development. The ontogenetic shift from serine endopeptidases (chymotrypsin) to cysteine endopeptidase (cathepsin L) indicates a profound biochemical and physiological change which, as a consequence, must also entail a shift in the acid/base household in the digestive organs and, probably, also in the mechanisms of enzyme secretion.

Related papers:

Navarrete del Toro M., Garcia-Carreno F., Diaz Lopez M., Celis-Guerrero L., Saborowski R. (2006) Aspartic Proteinases in the digestive Tract of Marine Decapod Crustaceans. Journal of Experimental Zoology 305A: 645-654