# Signalling Processes Involved in Queen Conch Metamorphosis

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ABSTRACT

Chemical cues are important in the exogenous and endogenous control of metamorphosis in many marine larvae. In most cases, the exact nature of the cue is unknown, and the manner in which larvae receive and transduce cues is not well understood. In order to understand theses process in the queen conch, *Strombus gigas*, the role of second messenger pathways in larval metamorphosis were examined. Past work with an artificial inducer of conch metamorphosis, $H_2O_2$ pointed to the importance of the phosphatidyl inositol signal transduction pathway. The current work focused on this pathway, examining the involvement of tyrosine kinases (TKs), protein kinase C (PKC), and arachidonic acid (AA). Activators of PKC induce queen conch metamorphosis, as does AA. Inhibitors of TKs, PKC, and AA block metamorphosis. These results were used to develop a model for signalling processes involved in the induction of conch metamorphosis and allowed for comparisons with other recognition based systems.

KEY WORDS: Larval metamorphosis, signalling, *Strombus gigas*

## INTRODUCTION



in conch nursery grounds (Davis 1994, Davis and Stoner 1994, Boettcher and Target 1996, 1998, Stoner et al. 1996). The free amino acids valine and isoleucine mimic the effects of the natural inducer, and may be recognized at the same sites as the algal cues (Boettcher and Targett 1998). Examinations of the effects of neuroactive compounds and manipulations of external ion concentrations suggest that metamorphosis may be triggered through second messengers, specifically those involved in the phosphatidyl inositol (PI) pathway (Davis et al. 1990, Boettcher et al. 1997, Boettcher and Targett 1998). In this study the role of this pathway in conch metamorphosis was examined by testing the responses of larvae to various blockers and activators of the PI pathway. Changes in the expression and phosphorylation of specific components of the signalling pathway during metamorphosis were also examined. The involvement of tyrosine kinases (TKs), protein kinase C (PKC), arachidonic acid (AA) and $Ca^{2+}$ were specifically addressed

## RESULTS AND DISCUSSION

Models for processes controlling the transduction of larval metamorphogenic signals have drawn on those developed for olfactory responses involving primarily the adenylate cyclase/cAMP (AC/cAMP) pathway and the PI pathway (see Morse 1990 and Leitz 1997 for reviews). Preliminary experiments with *S. gigas* indicated that the AC/cAMP pathway was not directly involved in the induction of metamorphosis for this species (Boettcher, unpublished data). These studies along with experiments examining the effects of hydrogen peroxide (Boettcher et al. 1997, Boettcher and Targett 1998) pointed to a role of the PI pathway. In the current study, activators of PKC, including phorbol esters and 1,2 dioctanoyl sn glycerol, were shown to induce queen conch metamorphosis, as was AA. Inhibitors of TKs (genistein and AG82), PKC (chelerythrine chloride and phloretin), and AA (lipoxygenase inhibitors) blocked metamorphosis. Manipulation of calcium concentrations and calcium channel blockers gave mixed results that suggest changes in internal calcium concentrations may influence the induction processes. Using the information provided by these experiments and models applied to other marine invertebrate larval systems (Leitz 1997), a model was developed for signalling during conch metamorphosis.

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NOTE: This is an expanded abstract and is not meant for citation purposes.