

# The short life of the Hoyle organ of *Sepia officinalis*: formation, differentiation and degradation by programmed cell death

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**Abstract** Cephalopods encapsulate their eggs in protective egg envelopes. To hatch from this enclosure, most cephalopod embryos release egg shell-digesting choriolytic enzymes produced by the Hoyle organ (HO). After hatching, this gland becomes inactive and rapidly degrades by programmed cell death. We aim to characterize morphologically the development, maturation and degradation of the gland throughout embryonic and first juvenile stages in *Sepia officinalis*. Special focus is laid on cell death mechanisms and the presence

of nitric oxide synthase during gland degradation. Hatching enzyme has been examined in view of metallic contents, commonly amplifying enzyme effectiveness. HO gland cells are first visualized at embryonic stage 23; secretion is observed from stage 27 onwards. Degradation of the HO occurs after hatching within two days by the rarely observed autophagic process, recognized for the first time in cephalopods. Nitric oxide synthase immunopositivity was not found in the HO cells after hatching, suggesting a possible NO role in cell death signalling. Although the HO 'life course' chronology in *S. officinalis* is similar to other cephalopods, gland degradation occurs by autophagy instead of necrosis. Eggs that combine a large perivitelline space

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