A NEW BIOASSAY FOR THE INVESTIGATION OF
A MEMBRANE-ASSOCIATED ECDYSTEROID RECEPTOR IN
DECAPOD CRUSTACEANS

by

K.-H. TOMASCHKO*, R. GUCKLER and D. BÜCKMANN

(Abteilung Allgemeine Zoologie, Universität Ulm, 89069 Ulm, Germany)

ABSTRACT

A new bioassay was designed to test the sensitivity and structure specificity of the
membrane-associated ecdysteroid receptor in decapod crustaceans. The oesophagus
dilatation assay (ODA) is based on an immediate reflex-like dilatation of the anterior
oesophagus that occurs in decapod crustaceans in response to overcritical concentra-
tions of ecdysteroids.

KEY WORDS: ecdysteroids, ecdysteroid receptor, chemical defense, feeding inhibition,
Pycnogonum litorale, Pantopoda, Carcinus maenas, bioassay.

Little is known about the extranuclear activities of ecdysteroids (ES).
From the few reports available (e.g. KAEUSER et al., 1990) it appears that
membrane-associated ecdysteroid receptors differ significantly from
the classical nuclear receptor with respect to their sensitivity and
structure specificity. The recent discovery of an allelochemical effect of
ES in marine arthropods (TOMASCHKO, 1944a,b) provides a new oppor-
tunity for research in this neglected field. The common shore crab
Carcinus maenas dose-dependently rejects food pellets containing 20-
hydroxyecdysone (20E) and 20-hydroxyecdysone 22-acetate
(20E22Ac) (TOMASCHKO, 1994a). The ability to perceive ES in the food
and the instantly resulting feeding inhibition suggest that in this case
the ES do not act via the classical mode of gene activation but by
interacting with membrane-associated compounds of sensory receptor
cells.

For the investigation of the structure-activity relationships of differ-
ent ES with this receptor mechanism, the above mentioned Carcinus
feeding assay has several drawbacks. When contained in food pellets,
the effect of a tested compound may be influenced by the solubility and
diffusion speed in the sea water, and the exact concentration at the site
of reception is uncertain. Therefore, we have developed a new bioassay
to test diluted compounds in solution quantities of 1 µl. This
oesophagus dilatation assay (ODA) is based on a reflex-like dilatation

* Address for correspondence.
of the anterior oesophagus (fig. 1b). This reaction can be observed when a test solution containing overcritical amounts of ES is administered directly to the antero-lateral oesophagus (fig. 1a). The oesophagus dilatation is part of the normal rejection behaviour of the crabs. Under natural conditions, it enables the crab to rinse the anterior oesophagus by ventilating it with the mouth-parts.

The EC$_{50}$ values for 20E and 20E22Ac in the Carcinus ODA are 1.8x10$^{-4}$ M and 4.6x10$^{-4}$ M, corresponding to 86.4 ng and 234.9 ng,