PHYSiOLOGICAL RESPONSE OF THE CRAYFISH,
ASTACUS LEPTODACTYLUSto SalINE WATeR

BY
HIJRAN YAVUZCAn YILDIZ1), GULTEN KÖKSAL and A. CAGLAN KARASU BENLI
Ankara University, Dept. of Fisheries and Aquaculture, TR-06110 Diskapi, Ankara, Turkey

INTRODUCTION

Crayfish can spend their whole life, including reproduction and development, in fresh water. It is considered that many advanced features, like direct development and maternal brood care, can be interpreted as adaptations to life in fresh water (Scholtz, 1995). However, crayfish may also be found in environments that are subject to variations in salinity (Holdich et al., 1997). Péqueux (1995) stated that, although under natural conditions most crayfish have adapted to a stenohaline way of life, they may survive to some degree in experimentally increased salinity. Cherkasina (1975) reported that Astacus leptodactylus Eschscholtz, 1823 and Astacus pachypus (Rathke, 1837) live in waters of up to 14 ppt salinity in the Caspian Sea. A. leptodactylus, the only crayfish native to Turkish waters, is known from estuarine environments. Köksal (1988) also reported A. leptodactylus from the Black Sea.

Various studies have been conducted on determining the salinity tolerance of a number of crayfish species through survival and growth trials (McMahon, 1986; Austin, 1995; Holdich et al., 1997; Susanto & Charmantier, 2000). Holdich et al. (1997) have shown that juveniles and adults of A. leptodactylus are well adapted to survive in salinities of at least 21 ppt in the long term, and to being transferred directly back into fresh water. However, some researchers state that their ability to colonize the estuarine environment may be restricted to areas of low salinity (Susanto & Charmantier, 2000) due to the adverse effects of sea water on egg development and hatching. Hence, consideration of a brackish-water environment may be more realistic.

The ability of A. leptodactylus to grow at relatively high salinities opens up the opportunity of culturing this species in brackish water and also provides the op-

1) Corresponding author; e-mail: Hijran.Yavuzcan@agri.ankara.edu.tr

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Also available online: www.brill.nl

Crustaceana 77 (10): 1271-1276
portunity for therapeutic saline baths to remove ectoparasites and ectocommensals (Austin, 1995).

Changes in environmental factors may induce alterations in the haemolymph parameters that may be useful in assessing stress, but there are no studies on crayfish that address salinity stress.

The aim of the present study was, therefore, to evaluate the stress response of *A. leptodactylus* when exposed to saline waters.

**MATERIALS AND METHODS**

Adult *Astacus leptodactylus* were obtained from Mogan Lake, Turkey. A total of 50 crayfish were used. Experiments were conducted on males and non-ovigerous females measuring 10.35 ± 0.58 cm in total length and weighing 26.68 ± 2.38 g.

Salinity was selected as 10 ppt, considering the value of estuarine salinity. Crayfish were directly transferred from fresh water to 10 ppt salinity. The experimental medium was prepared by adding “Instant Ocean” to aerated tap water. The experiment was carried out in ten 80 l aquaria filled to a volume of 20 l. For the experiments, each aquarium was stocked with 5 crayfish. Crayfish in aerated tap water were used as a control. Before the experiment, crayfish were fed with fragments of marine fish. During the experiment they were not fed.

Haemolymph samples were taken after 0, 1, 2, 6, and 24 h, and subsequently after 48, 72, and 96 h. The measurements of 0 h haemolymph samples were used as a control. Each animal was marked on the cephalothorax with a permanent marker pen to avoid reusing it for following samplings.

Haemolymph samples of 0.1 ml were collected from the heart via a syringe. Haemolymph glucose was determined by the Clonital Trinder Method. Haemolymph Ca$^{++}$ was determined by the MTB Colorimetric Method, and Mg$^{++}$ by the Calmagite Method using the kits of Clonital (Italy); haemolymph Na$^{+}$ and K$^{+}$ were determined by using the kits of Teco Diagnostics (U.S.A.) with a Schimadzu UV-1201V spectrophotometer. Total haemolymph protein was estimated according to Santos & Moreira (1999). Haemolymph pH was determined using a Metrohm Herisau E 532 digital pH-meter.

Differences between means were tested for significance by one-way analysis of variance (ANOVA); if appropriate, the Duncan test was performed.

**RESULTS**

Exposure of *Astacus leptodactylus* to a salinity of 10 ppt resulted in changes in the selected haemolymph parameters (table I). Glucose values increased following