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ORIGINAL PAPER

**Sarah B. Doernberg · Stuart I. Cromarty
Ralf Heinrich · Barbara S. Beltz · Edward A. Kravitz**

Agonistic behavior in naïve juvenile lobsters depleted of serotonin by 5,7-dihydroxytryptamine

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Abstract We have been exploring the role of serotonin in fighting behavior in lobsters using a specific model of agonistic behavior, the establishment of hierarchical relationships between pairs of socially naïve juvenile lobsters. We selected this model because the behavior is easily evoked, readily quantifiable, and the effects of experience are eleminated by using socially naïve animals. In these studies we injected a specific neurotoxin, 5,7-dihydroxytryptamine, into juvenile lobsters over a 4-week period and then measured the effects on fighting behavior. This treatment reduces the levels of serotonin in the nervous system and immunocytochemical studies show a dramatic reduction in neuropil staining for the amine. Control animals received vehicle injection alone. All injected animals were paired against larger or smaller non-injected opponents, and three successive 30-min fights were carried out and statistically analyzed. The results were surprising: As with elevations of serotonin, reduced levels of serotonin increased the amount of time animals engaged in fighting behavior. No significant effects were seen on who initiated encounters, who retreated first, or who the eventual winner would be. Thus, in this model, elevation or reduction of serotonergic function increases the tendency of animals to engage in agonistic encounters.

Key words Crustacea · Lobster · Agonistic behavior · Serotonin · 5,7-DHT

Abbreviations *5HT* serotonin · *5,7-DHT* 5,7-dihydroxytryptamine · *OCT* octopamine

S. B. Doernberg · S. I. Cromarty · R. Heinrich
E. A. Kravitz (✉)
Harvard Medical School, Department of Neurobiology,
220 Longwood Avenue, Boston, MA 02115, USA
E-mail: edward_kravitz@hms.harvard.edu
Tel.: +1-617-4321042
Fax: +1-404-7347557

B. S. Beltz
Wellesley College, Department of Biology,
Wellesley College, Wellesley, MA 02181, USA

S. I. Cromarty
Present address: Assumption College,
Division of Natural Sciences, 500 Salisbury Street,
P.O. Box 15005, Worcester, MA 01615-0005, USA

R. Heinrich
Present address: Institut für Zoologie, Berliner Str. 28,
37073 Göttingen, Germany

Introduction

For close to a decade, we have been using a model of a specific type of agonistic behavior, the establishment of hierarchical relationships between pairs of socially naïve juvenile lobsters, to explore the role of humoral substances in fighting behavior (Huber and Kravitz 1995; Huber et al. 1997a, 1997b). We selected this model because the behavior is easily evoked and readily quantifiable (Huber and Kravitz 1995) and because we avoid the effects of social experience on the behavior through the use of socially naïve juvenile animals. Our studies have focused on the role of the amines serotonin (5HT) and octopamine (OCT) in the behavior (for reviews see Kravitz 1988, 2000; Edwards and Kravitz 1997). 5HT has been implicated in aggression in a large number of vertebrate and invertebrate species, including man, but the relationships between the amine and the behavior are not simple (for reviews see Soubrié 1986; Miczek et al. 1994). To illustrate, the generalization that lowered levels of 5HT correlate with enhanced aggression in vertebrates cannot be made without reference to the brain region in which 5HT levels have been lowered, the type of aggression being studied, the experimental design used to test aggression, and the social status, gender, parental status and hormonal state of the animals involved (cf. Raleigh et al. 1985; Sijbesma et al. 1991; Ison et al. 1996; Koprowska and Romaniuk 1997; Harrison et al. 1997; Söderpalm and Svensson 1999; Chung et al. 1999). Similar considerations apply in crustacean models