J A I	12891	WILEY	Dispatch: 31.8.15	CE: Deepika
Journal Code	Manuscript No.		No. of pages: 7	PE: Sakthivel Ramalingam

J. Appl. Ichthyol. (2015), 1–7

ISSN 0175–8659

Received: September 25, 2014
Accepted: May 1, 2015
doi: 10.1111/jai.12891

The effects of gradual or abrupt changes in salinity on digestive enzymes activity of Caspian kutum, *Rutilus kutum* (Kamensky, 1901) larvae

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Summary

This study investigates the effects of gradual or abrupt changes in rearing salinity on food transit time and digestive enzymes activity of Caspian kutum (*Rutilus kutum*) larvae. The larvae (532 ± 0.05 mg) were supplied and randomly allocated into 12 tanks at a density of 45 fish per tank. Experimental treatments were fresh water (salinity 0) [FW] as control, exposure to salinity 5 [T_1], and gradual transfer to salinity 10 in two steps of first to 5 h, then and after 12 h to a salinity of 10 [T_2], and abrupt change (direct transfer to a salinity of 10 [T_3]). Results showed at 8 h after start of feeding that the larvae intestine was filled with food pellets except in treatment T_1. Enzyme activity responded to salinity change as follows: the highest trypsin, amylase, and chymotrypsin activities were observed in T_1; however, these were not significantly different to treatment T_3 ($P > 0.05$). Trypsin activity peaks in the FW and T_2 groups occurred 8 h after feeding, and in T_3 and T_1 groups 5 h after feeding. Peak chymotrypsin and alkaline phosphatase activity was observed 5 and 8 h after feeding in all experiments, respectively. The highest α amylase activity in FW and T_2 groups occurred 5 h after feeding, while in T_3 and T_1 these peaks were observed 8 h after feeding. These results indicate that salinity had some noticeable effects on the activities of digestive enzymes after feeding.

Introduction

Caspian kutum (*Rutilus kutum*) is a herbivorous species, thriving in the estuarine, coastal, and continental shelf waters of the southern Caspian Sea (Abdoli, 1999). The Iranian Shilat organization is engaged in controlled propagation of this species and each year around 200 million fry (~ 1 g) are released into southern river estuaries with varying salinities for stock enhancement purposes. Thus water salinity at release sites is an important environmental consideration, which can affect the standard metabolic rate, food intake, food conversion and hormonal stimulation (Boeuf and Payan, 2001).

The alkaline nature of ingested seawater may result in modifications of the physico-chemical conditions of the gut lumen and epithelium (Usher et al., 1990) and may exert a direct action on digestive enzyme performance (Boeuf and Payan, 2001). The effects of salinity on the digestive enzyme activity of euryhaline teleosts have already studied. Barman et al. (2005) reported high digestibility, feed conversion efficiency and total intestinal proteolytic activity, coupled with a high growth rate of *Mugil cephalus* at a salinity of 10. In addition, a reduced salinity of 7 increased digestibility and intestinal trypsin activity in *Sparus sarba* compared to fish held in salinities of 15 and 35 (Woo and Kelly, 1995). Moreover, efficiency of the enzyme function and digestive processes can be related to the time required for food hydrolysis and required enzyme levels in the gut (Olsson and Holmgren, 2001; Uscanga et al., 2010). The first parameter is determined by measurement of the food transit time, which is typically influenced by a number of parameters such as fish species, physiological conditions, feed composition, amount of food intake as well as temperature and salinity (Uscanga et al., 2010). Information on gastric evacuation is rare for herbivorous fish species like Caspian kutum (Zhen et al., 2009). The present study was designed to investigate the effects of changes in low estuarine salinity levels on food evacuation time and the activities of digestive enzymes in the intestine of Caspian kutum (*Rutilus kutum*) larvae/juveniles after transfer to brackish water conditions.

Materials and methods

Experimental design

Rutilus kutum larvae were supplied by the Sijaval Fish Farm (Golestan province, Iran). Fish were acclimated to laboratory conditions for two weeks in three tanks (300-L) with stocking densities of 200 fish per tank. Water temperature and photoperiod was 25 ± 0.4°C and 12:12 h, respectively, and dissolved oxygen (90–100% saturation) was monitored daily. During the acclimation period, fish were fed twice per day on a formulated commercial diet (Biomar, 0.8 mm). Thereafter, 540 specimens (532 ± 50.0 mg) were randomly stocked in 12 fiberglass tanks (300-L; 45 fish per tank) assigned to four treatments in triplicate. The experimental conditions were fresh water (0) [FW] as control, abrupt change to a salinity of 5 [T_1], gradual change to a salinity of 10 [T_2] (transferred from fresh water to 5 and after 12 h transferred to a salinity of 10) and abrupt change to a salinity of 10 [T_3]. Fish performance was followed for 20 days after