



## SHORT COMMUNICATION

### The effects of crowding stress on some epidermal mucus immune parameters, growth performance and survival rate of tiger barb (*Puntius tetrazona*)

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The controls of fish size and production are two essential tasks in aquaculture practices to meet the market demands and increasing the stocking density is one of the important strategies for the elevation of production per unit area (Yarahmadi, Miandare, Hoseinifar, Gheysvandi & Akbarzadeh 2014). The adverse effects of crowding as a stressor can be attributed to changes in environmental factors such as reduced water quality (Rafatnezhad, Falahatkar & Tolouei Gilani 2008) or more directly to the induction of a stress response (Tort, Sunyer, Gómez & Molinero 1996). Furthermore, fish culture under over-crowding conditions has been shown to have negative effects on immune functions (Yin, Lam & Sin 1995). However, to the best of our knowledge, there is no report on the effects of crowding stress on epidermal mucus immune parameters especially in ornamental fish.

The epidermal mucus is considered as a first defence line and contains a variety of biologically active substances such as lysozyme, lectins, proteolytic enzymes, immunoglobulins and C-reactive protein (Subramanian, MacKinnon & Ross 2007; Roosta, Hajimoradloo, Ghorbani & Hoseinifar 2014). The composition and mucus secretion rate have been observed to change in response to microbial exposure or due to environmental factors (Subramanian, Ross & MacKinnon 2008).

Tiger barb (*Puntius tetrazona*) is a commercially important ornamental fish that is considered as a native species in Southeast Asian countries (Ng &

Tan 1997). Similar to other fish species, there is no information about the effects of stocking density on skin mucus immune parameters of tiger barb. Therefore, the aim of this study was to evaluate the effects of crowding stress on some epidermal mucus immune parameters, growth performance and survival rate of tiger barb.

Five hundred and forty tiger barb ( $2.17 \pm 0.11$  g) were obtained from a private fish farm and stocked in nine aquaria (65 L), which were randomly assigned to three treatments that were different stocking densities: 40 ( $T_1$ ), 60 ( $T_2$ ) and 80 ( $T_3$ ) specimens per aquarium in triplicates. Fish were cultured for 4 weeks, and during this period, they were hand-fed two times a day with a commercial food (Biomar-Fance).

The growth parameters and survival rate of tiger barb were calculated at the end of trial using following formula:

$$\text{Weight gain (WG, g)} = W_t \text{ (g)} - W_i \text{ (g)}$$

$$\begin{aligned} \text{Specific growth rate (SGR, \% day}^{-1}\text{)} \\ = 100 \times (\ln W_t - \ln W_i) / t \end{aligned}$$

$$\begin{aligned} \text{Condition factor (CF, \%)} \\ = 100 \times (\text{body weight, g}) / (\text{body length, cm})^3 \end{aligned}$$

$$\begin{aligned} \text{Survival (\%)} = 100 \times (\text{final amount of fish}) / \\ (\text{initial amount of fish}) \end{aligned}$$