

## ACUTE EXPOSITION OF COMMON SNOOK JUVENILES TO SUBLETHAL LEVELS OF NITRATE

### Exposición aguda de juveniles de róbalo común a niveles subletales de nitrato

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#### ABSTRACT

The present study aimed to evaluate nitrate acute toxicity in cultured common snook *Centropomus undecimalis* juveniles. Fish (20.35±6.10 g and 13.90±1.75 cm) were submitted to a control treatment (without nitrate addition) plus 20 increasing concentrations of nitrate up to 2735 mg L<sup>-1</sup> obtained by sodium nitrate. System was semi-static, with 100 % daily water renewed and sodium nitrate addition to maintain the respective concentrations. Water temperature was 20.99±0.55 °C, dissolved oxygen 6.79±0.21 mg L<sup>-1</sup>, pH 8.23±0.10, alkalinity 141.80±7.68 mg L<sup>-1</sup> CaCO<sub>3</sub>, salinity 33.47±3.75 g L<sup>-1</sup>, total ammonia and nitrite less than 1 mg L<sup>-1</sup>. During experimental period (96 h), no mortalities were observed in fish with or without nitrate addition. Compared to other species, the common snook presents higher tolerance to nitrate exposition. Based on the present findings, the acute nitrate exposure up to 2735 mg L<sup>-1</sup> does not present lethal risk for common snook juveniles.

**Keywords:** Centropomidae, marine fish, nitrogen.

#### RESUMEN

El presente estudio tuvo como objetivo evaluar la toxicidad aguda de nitrato en juveniles cultivados del róbalo común *Centropomus undecimalis*. Los peces (20,35±6,10 g y 13,90±1,75 cm) se sometieron a un tratamiento control (sin adición de nitrato) además de más de 20 concentraciones crecientes de nitrato hasta 2735 mg L<sup>-1</sup> obtenidas con nitrato de sodio. El sistema era semiestático, con 100 % de renovación diaria de agua y adición de nitrato de sodio para mantener las respectivas concentraciones. La temperatura del agua fue 20,99±0,55 °C, oxígeno disuelto 6,79±0,21 mg L<sup>-1</sup>, pH 8,23±0,10, alcalinidad 141,80±7,68 mg L<sup>-1</sup> CaCO<sub>3</sub>, salinidad 33,47±3,75 g L<sup>-1</sup>, amoníaco total y nitrito menor que 1 mg L<sup>-1</sup>. Durante el período experimental, no se observaron mortalidades en peces con o sin adición de nitrato. Comparado con otras especies, el róbalo común es más resistente a exposición de nitrato. Con base en los hallazgos actuales, la exposición aguda a nitrato hasta 2735 mg L<sup>-1</sup> no presenta un riesgo letal para los juveniles de róbalo.

**Palabras claves:** Centropomidae, nitrógeno, peces marinos.

As nitrate is the final product in nitrification process, it may reach high concentrations, especially in recirculating aquaculture systems (Hamlin, 2006). In this case, sublethal or lethal effects might occur in fish (Poerch *et al.*, 2007), affecting growth and reproduction (Hamlin *et al.*, 2008), endocrine functions and secondary responses of stress (Hamlin, 2006; Pottinger, 2017) and also histopathologies in gills, esophagus and brain (Shimura *et al.*, 2004; Rodrigues *et al.*, 2011). However, little attention has been

given in literature (Rodrigues *et al.*, 2011) and mechanisms of nitrate toxicity are still poorly understood in marine fish (Hamlin, 2006).

Among centropomid fish, the common snook *Centropomus undecimalis* (Bloch 1972) is one of the most promising species for aquaculture (Souza-Filho and Cerqueira, 2003) and has great potential considering the Brazilian coast (Cavalli *et al.*, 2011). Found in tropical and subtropical estuaries and coastal environments of the Atlantic Ocean (Brennan *et al.*,

2006), it has been studied in America, as the United States (Hauville *et al.*, 2016; Yanes-Roca *et al.*, 2009), Mexico (Ibarra-Castro, Jimenez-Martinez), Colombia (Cruz-Botto *et al.*, 2018), Venezuela (Figueredo-Rodrigues and Fuentes, 2018) and Brazil (Cerqueira *et al.*, 2017; Pedrotti *et al.*, 2018; Michelotti *et al.*, 2018, Passini *et al.*, 2018). Because no information is available about nitrate safe levels for this species, the present study aimed to evaluate nitrate acute toxicity in cultured common snook juveniles.

All animal handlings were in according accordance with to the Ethic Committee on the Animal Use of the UFSC (PP00861 n<sup>o</sup> 82/CEUA/PROPESQ/2013). Fish (20.35±6.10 g and 13.90±1.75 cm) (Passini *et al.*, 2016) were acclimated for ten days fed *ad libitum* with commercial feed (45 % PB), in 100 % renewed water per day with aeration. Treatments consisted of a control, without nitrate addition, plus 20 increasing concentrations of nitrate (100, 250, 400, 550, 700, 850, 1000, 1150, 1300, 1450, 1600, 1750, 1900, 2000, 2200, 2300, 2400, 2500, 2600 and 2735 mg L<sup>-1</sup>) obtained by addition of sodium nitrate (Dynamics, São Paulo, Brazil). Trial was carried out in triplicate for 96 h, using 60 circular fiber tanks filled with 60 L of marine water, containing five fish in each, observed twice a day (08 am and 06 pm). System was semi-static, with 100 % water renewed daily and sodium nitrate addition to maintain the respective concentrations. Fish were maintained at 20.99±0.55 °C, dissolved oxygen 6.79±0.21 mg L<sup>-1</sup>, pH 8.23±0.10, alkalinity 141.80±7.68 mg L<sup>-1</sup> CaCO<sub>3</sub>, salinity 33.47±3.75 g L<sup>-1</sup>, total ammonia and nitrite less than 1 mg L<sup>-1</sup>.

During experimental period (96 h), no mortalities were observed in fish with or without nitrate addition. Nonetheless, considering toxicant safety levels are equivalents to 10 % of LC<sub>50</sub> 96 h (Sprague, 1971), fish may have suffered sublethal effects. Despite mechanisms of nitrate toxicity in fish are not completely understood (Hamlin, 2006), increasing methaemoglobin levels appears to be associated, causing mortality due to suffocation (Camargo *et al.*, 2005).

It is known nitrate toxicity varies mainly among species (Rodrigues, 2011), fish size (Hamlin, 2006) and water salinity (Tisai and Chen, 2002). Considering the survival rate presented in this study, the common snook presents great resistance to nitrate when compared to other species (Knepp and Arkin, 1973; Rubin and Elmaraghy, 1977; Kincheloe *et al.*, 1979; Frakes and Hoff, 1982; Pierce *et al.*, 1993; Tilak *et al.* 2007). Regarding other marine fish, nitrate median lethal concentration (LC<sub>50</sub>) 96 h were 1006 mg L<sup>-1</sup> for *Florida pompano* juveniles (Pierce *et al.*, 1993), 1522 mg L<sup>-1</sup> for mullet fingerlings (Poersch *et al.*, 2007) and 1829 mg L<sup>-1</sup> for cobia juveniles (Rodrigues *et al.*, 2011). Thus, as nitrate toxicity significantly depends on specific variations, it is essential to study its effects on different species (Poersch *et al.*, 2007).

In this context, acute toxicity tests are important tools for determining nitrate safety levels in aquaculture, especially considering recirculation systems (Rodrigues *et al.*, 2011).

Based on the present findings, the acute exposure of nitrate up to 2735 mg L<sup>-1</sup> does not present lethal risk for common snook juveniles.

## CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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