



Acta Biológica Colombiana

ISSN: 0120-548X

Universidad Nacional de Colombia, Facultad de Ciencias,
Departamento de Biología

PEDROTTI, Fabiola; MAGNOTTI, Caio; STERZELECKI, Fabio; CERQUEIRA, Vinicius
ACUTE EXPOSITION OF COMMON SNOOK JUVENILES TO SUBLETHAL LEVELS OF NITRATE

Acta Biológica Colombiana, vol. 23, no. 3, 2018, September-December, pp. 304-306

Universidad Nacional de Colombia, Facultad de Ciencias, Departamento de Biología

DOI: <https://doi.org/10.15446/abc.v23n3.69726>

Available in: <https://www.redalyc.org/articulo.oa?id=319057440009>

- How to cite
- Complete issue
- More information about this article
- Journal's webpage in redalyc.org

UNEN
redalyc.org

Scientific Information System Redalyc

Network of Scientific Journals from Latin America and the Caribbean, Spain and
Portugal

Project academic non-profit, developed under the open access initiative



ACUTE EXPOSITION OF COMMON SNOOK JUVENILES TO SUBLETHAL LEVELS OF NITRATE

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

Fabiola PEDROTTI¹, Caio MAGNOTTI¹, Fabio STERZELECKI¹, Vinicius CERQUEIRA².

¹ Laboratory of Marine Fisheries (LAPMAR), Aquaculture Department, Agricultural Sciences Center (CCA), Federal University of Santa Catarina (UFSC). Rua dos Coroa 503. Florianópolis, SC, Brazil.

*For correspondence. fabiola.pedrotti@ufsc.br

Received: 14th February 2018, Returned for revision: 7th March 2018, Accepted: 21st June 2018.

Associate Editor: Alan Giraldo.

Citation/Citar este artículo como: Pedrotti F, Magnotti C, Sterzelecki F, Cerqueira V. Acute exposition of common snook juveniles to sublethal levels of nitrate. Acta biol. Colomb. 2018;23(3):304-306. DOI:<http://dx.doi.org/10.15446/abc.v23n3.69726>

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⁻¹ 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⁻¹, pH 8.23±0.10, alkalinity 141.80±7.68 mg L⁻¹ CaCO₃, salinity 33.47±3.75 g L⁻¹, total ammonia and nitrite less than 1 mg L⁻¹. 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⁻¹ 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⁻¹ 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⁻¹, pH 8,23±0,10, alcalinidad 141,80±7,68 mg L⁻¹ CaCO₃, salinidad 33,47±3,75 g L⁻¹, amoníaco total y nitrito menor que 1 mg L⁻¹. 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⁻¹ 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-Rodriguez 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° 82/CEUA/PROPSQ/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⁻¹) 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⁻¹, pH 8.23±0.10, alkalinity 141.80±7.68 mg L⁻¹ CaCO₃, salinity 33.47±3.75 g L⁻¹, total ammonia and nitrite less than 1 mg L⁻¹.

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 LC₅₀ 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 (LC₅₀) 96 h were 1006 mg L⁻¹ for *Florida pompano* juveniles (Pierce *et al.*, 1993), 1522 mg L⁻¹ for mullet fingerlings (Poersch *et al.*, 2007) and 1829 mg L⁻¹ 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⁻¹ does not present lethal risk for common snook juveniles.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

REFERENCES

- Brennan NP, Darcy MC, Leber KM. Predator-free enclosures improve post-release survival of stocked common snook. *J Exp Mar Bio Ecol.* 2006;335(2):302-311. Doi:10.1016/j.jembe.2006.04.001
- Camargo JA, Alonso A, Salamanca A. Nitrate toxicity to aquatic animals: a review with new data for freshwater invertebrates. *Chemosphere.* 2005;58:1255-1267. Doi:10.1016/j.chemosphere.2004.10.044
- Cavalli RO, Domingues EC, Hamilton S. Desenvolvimento da produção de peixes em mar aberto no Brasil: possibilidades e desafios. *Revista Brasileira de Zootecnia.* 2011;40(supl):155-164.
- Cerqueira VR, Carvalho, CVC, Sanches EG, Passini G, Baloi M, Rodrigues, RV. Manejo de reprodutores e controle da reprodução de peixes marinhos da costa brasileira. *Rev Bras Reprod Anim.* 2017; 41:94-102.
- Cruz-Botto S, Roca-Lanao B, Gaitán-Ibarra S, Chaparro-Muñoz N, Villamizar N. Natural vs laboratory conditions on the reproductive biology of common snook *Centropomus undecimalis* (Bloch, 1792). *Aquaculture.* 2018;482:9-16. Doi:10.1016/j.aquaculture.2017.09.013
- Figueredo-Rodríguez AJ, Fuentes JL. Monogenesis en juveniles de *Centropomus undecimalis* (Bloch, 1792) (Perciformes: Centropomidae) de la Laguna la Restinga, Isla de Margarita, Venezuela. *Bol Inst Oceanogr Venez.* 2018;56(02).
- Frakes T, Hoff FH. Effect of high nitrite-N on the growth and survival of juvenile and larval anemone fish, *Amphiprion ocellaris*. *Aquaculture.* 1982;29:155-158. Doi:10.1016/0044-8486(82)90042-4
- Hamlin HJ. Nitrate toxicity in Siberian sturgeon (*Acipenser baeri*). *Aquaculture.* 2006;253:688-693. Doi:10.1016/j.aquaculture.2005.08.025
- Hamlin HL, Moore BC, Edwards TM, Larkin ILV, Boggs A, High WJ *et al.* Nitrate-induced elevations in circulating sex steroid concentrations in female Siberian sturgeon (*Acipenser baeri*) in commercial aquaculture. *Aquaculture.* 2008;281:118-125. Doi:10.1016/j.aquaculture.2008.05.030
- Hauville MR., Main KL, Migaud H, Gordon Bell J. Fatty acid utilization during the early larval stages of Florida pompano (*Trachinotus carolinus*) and Common snook (*Centropomus undecimalis*). *Aquac res.* 2016;47(5):1443-1458. Doi:org/10.1111/are.12602
- Ibarra-Castro L, Alvarez-Lajonchère L, Rosas C, Palomino-Albarrán IG, Holt GJ, Sanchez-Zamora A. GnRHa-

- induced spawning with natural fertilization and pilot-scale juvenile mass production of common snook, *Centropomus undecimalis* (Bloch, 1792). *Aquaculture*. 2011;319(3-4):479-483.
- Jimenez-Martinez LD, Alvarez-González CA, Tovar-Ramírez D, Gaxiola G, Sanchez-Zamora A, Moyano FJ, Perales-García N. Digestive enzyme activities during early ontogeny in Common snook (*Centropomus undecimalis*). *Fish Physiol Biochem*. 2012;38(2):441-454.
- Kincheloe JW, Wedemeyer GA, Koch DL. Tolerance of developing salmonid eggs and fry to nitrate exposure. *Bull Environ Contam Toxicol*. 1979;23:575-578.
- Knepp GL, Arkin GF. Ammonia toxicity levels and nitrate tolerance of channel catfish. *N Am J Aquac*. 1973;35:221-224. Doi:10.1577/1548-8659(1973)35[221:ATLANT]2.0.CO;2
- Michelotti BT, Passini G, Carvalho C, Salbego J, Mori NC, Rodrigues RV, Cerqueira VR. Growth and metabolic parameters of common snook juveniles raised in freshwater with different water hardness. *Aquaculture*. 2018;482:31-35. Doi:10.1016/j.aquaculture.2017.08.029
- Passini G, Sterzelecki FC, de Carvalho CVA, Baloi MF, Naide V., Cerqueira VR. 17 α -Methyltestosterone implants accelerate spermatogenesis in common snook, *Centropomus undecimalis*, during first sexual maturation. *Theriogenology*. 2018;106:134-140. Doi:10.1016/j.theriogenology.2017.10.015
- Passini G, Carvalho CVA, Sterzelecki FC, Cerqueira VR. Induction of sex inversion in common snook (*Centropomus undecimalis*) males, using 17- β oestradiol implants. *Aquac Res*. 2016;47:1090-1099. Doi:10.1111/are.12565
- Pedrotti F, Martins ML, Baloi M, Magnotti C, Scheuer F, Sterzelecki F, Cerqueira V. Mortality, hematology, and histopathology of common snook *Centropomus undecimalis* (Perciformes: Centropomidae) exposed to acute toxicity of ammonia. *J Appl Aquac*. 2018;1-13. Doi:10.1080/10454438.2018.1443049
- Pierce RH, Weeks JM, Prappas JM. Nitrate toxicity to five species of marine fish. *J World Aquac Soc*. 1993;24:105-107. Doi:10.1111/j.1749-7345.1993.tb00156.x
- Poersch LH, Santos MH, Miranda Filho K, Wasielesky JrW. Efeito agudo do nitrato sobre alevinos da tainha *Mugil platanus* (Pisces: Mugilidae). *Bol Inst Pesca*. 2007;33(2):247-252.
- Pottinger TG. Modulation of the stress response in wild fish is associated with variation in dissolved nitrate and nitrite. *Environ Pollut*. 2017;225:550-558. Doi:10.1016/j.envpol.2017.03.021
- Rodrigues RV, Schwarz MH, Delbos BC, Carvalho EL, Romano LA, Sampaio LA. Acute exposure of juvenile cobia *Rachycentron canadum* to nitrate induces gill, esophageal and brain damage. *Aquaculture*. 2011;322:223-226. Doi:10.1016/j.aquaculture.2011.09.040
- Rubin AJ, Elmaraghy GA. Studies on the toxicity of ammonia, nitrate and their mixtures to guppy fry. *Water Res*. 1977;11:927-935. Doi:10.1016/0043-1354(77)90079-3
- Shimura R, Ma YX, Ijiri K, Nagaoka S, Uchiyama M. Nitrate toxicity on visceral organs of medaka fish, *Oryzias latipes*: aiming to raise fish from egg to egg in space. *Biol Sci Space*. 2004;18:7-12.
- Souza-Filho JJ, Cerqueira VR. Influência da densidade de estocagem no cultivo de juvenis de robalo-flecha mantidos em laboratório. *Pesqui Agropecu Bras*. 1997;38(11):1317-1322. Doi:10.1590/S0100-204X2003001100010
- Sprague JB. Measurement of pollutant toxicity to fish III. Sublethal effects and "safe" concentrations. *Water Res*. 1971;5:245-266. Doi:10.1016/0043-1354(71)90171-0
- Tilak KS, Veeraiah K, Raju JMP. Effects of ammonia, nitrite and nitrate on hemoglobin content and oxygen consumption of freshwater fish, *Cyprinus carpio* (Linnaeus). *J Environ Biol*. 2007;28:45-47.
- Tisai SJ, Chen JC. Acute toxicity of nitrate on *Penaeus monodon* juveniles at different salinity levels. *Aquaculture*. 2002;213:163-170. Doi:10.1016/S0044-8486(02)00023-6
- Yanes-Roca C, Rhody N, Nystrom M, Main KL. Effects of fatty acid composition and spawning season patterns on egg quality and larval survival in common snook (*Centropomus undecimalis*). *Aquaculture*. 2009;287(3-4):335-340. Doi:10.1016/j.aquaculture.2008.10.043