INFLUENCE OF TEMPERATURE ON THE LEVEL OF AGGRESSIVENESS OF RED TILAPIA (*Oreochromis* spp.)

by

LAURA MARIE C. BENIGNO

An Undergraduate Thesis submitted to the faculty of the College of Fisheries in partial fulfilment of the requirements of the degree of

BACHELOR OF SCIENCE IN FISHERIES

Department of Aquaculture
COLLEGE OF FISHERIES
CENTRAL LUZON STATE UNIVERSITY
Science City of Muñoz, Nueva Ecija
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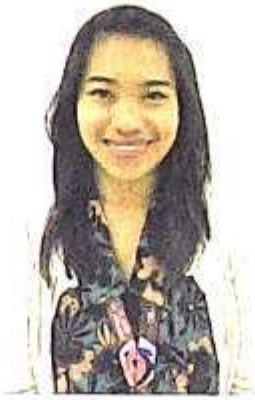

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INFLUENCE OF TEMPERATURE ON THE LEVEL OF AGGRESSIVENESS OF RED TILAPIA (*Oreochromis* spp.)[1/]

ABSTRACT

Thirty (30) red tilapia were used to determine level of aggression as affected by different levels of temperature. Treatments usedwere 29°C, 31°C, 33°C, 35°C and 37°C and were replicated thrice.

During the three-day interaction period, mean ECP of fish at 29°C (2.69±1.67) and 31°C (2.91±1.91) were significantly higher than those at 33°C (1.29±1.06) and 37°C (1.50±1.04) but comparable to that at 35°C (1.67±1.65). Mean ECP of fish at 35°C was not significantly different from those at 33°C and 37°C. Higher mean ECP was observed at lower temperature, which is in contrast to the results of studies on Nile tilapia where higher ECP was observed during stressful condition i.e. higher temperature.

Meanwhile, mean VR of fish was significantly higher at 33°C (2.39±0.39 beats/sec) and 35 °C (2.37±0.27 beats/sec) than those at 29°C (1.92±0.39 beats/sec) and 31°C (2.00±0.42 beats/sec) but not significantly different compared to that at 37 °C (2.21±0.65). Mean VR of fish at 29 °C was also comparable to that at 31 °C. Mean VR values increased as the temperature increased up to 33°C, then gradually decreased up to 37°C. The decrease in VR was due to increase in the opening of the operculum and mouth during respiration, as the fish were gasping for oxygen that resulted to lesser operculum movements per second. Higher VR was observed at higher temperature, except when the temperature was too high to cause death of the fish;

Body color of fish was also observed and skin color of red tilapia exposed in high temperature became more reddish compared to the control or ideal temperature of water. Dominant red tilapia exhibited darker body coloration while the subordinate exhibited paler body coloration.

Numbers of attacks were observed in 10 minutes daily. There is no significant difference on numbers of attacks among the treatments (P=0.153, n=40)., It was also observed that in day 1, Treatment 2 (31°C) had the highest number of attacks (68.33±16.92), while in day 2, Treatment 3 (33°C) showed the highest number of attacks (125.67±69.42), and in day 3, Treatment 1 (29°C) showed the highest number of attacks (88.66±31.78). In Treatments 1, 2, 3 and 4 subordinate fish had died due to wounds caused by the attacks of dominant fish. In Treatment 5, there were mortalities due to the exposure to higher temperature.

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LITERATURE CITED

Alvarenga, C.M.D. and G.L. Volpato. 1995. Agonistic profile and metabolism in alevins of the Nile tilapia. Physiology and Behavior, 57: 75–80.

Azaza, M.S., M.N. Dhraïef and M.M. Kraïem. 2008. Nile tilapia *Oreochromis niloticus* (Linnaeus) reared in geothermal waters in southern Tunisia. Journal of Thermal Biology, 33(2): 98–105.

Balcázar, J.L., A. Aguirre, G. Gómez andW. Paredes. 2006. Culture of hybrid red tilapia (*Oreochromis mossambicus*× *Oreochromis niloticus*) in marine cages: effects of stocking density on survival and growth. Retrieved from http://citeseerx.ist.psu.edu on December 13, 2016.

Barreto, R.E. and G.L.Volpato. 2011. Ventilation rates indicate stress-coping styles in Nile tilapia. Journal of Bioscience, 35:1-5.

Barley, A.J. and R.M. Coleman. 2010. Habitat structure directly affects aggression in convict cichlids *Archocentrus nigrofasciatus*. Current Zoology 56 (1): 52□56.

Beitinger, T.L., W.A. Bennett, and R.W. McCauley. 2000. Temperature tolerances of North American freshwater fishes exposed to dynamic changes in temperature.Environmental Biology of Fishes, 58:237–275.

Biro, P.A., C. Beckmannand J.A Stamps .2009. Small within-day increases in temperature affects boldness and alters personality in coral reef fish. Proc. R. Soc. B, 277: 71–77.

Brett, J. R. 1971. Energetic responses of salmon to temperature: a study ofsome thermal relations in the physiology and freshwater ecology of sockeye salmon (*Oncorhynchus nerka*). Am. Zool.11: 99-113.

Dela Cruz, M.J.D. 2017. Stress response of Nile Tilapia (*Oreochromis niloticus* L.) in different water temperatures. Undergraduate Thesis, College ofFisheries, Central Luzon State University, Science City of Muñoz, Nueva Ecija. p. 45.

Del Pilar, R.C. 2016. Behavioral response of Red Tilapia (*Oreochromis* sp.) to high water temperature. Undergraduate Thesis, College of Fisheries, Central Luzon State University, Science City of Muñoz, Nueva Ecija. p. 40.

El-Sayed, A.M. 2006. Tilapia culture in salt water: environmental requirements, nutritional implications and economic potentials. p. 95-106. *In*: L.Elizabeth Cruz Suarez, D. Ricque Marie, M.T. Salazar, M.G. Nieto Lopez, D.A. VillarealCovazos, A.C. Puello Cruz y Armando Garcia Ortega (Eds.). Advances

on Aquaculture Nutrition, VIII 95-106. VIII SimposiumInternacional de NutricionAquicola, Universidad Autonoma de Nuevo Leon Monterrey, Nuevo Leon, Mexico. p. 380.

El-zaeem. S.Y., M.M.M. Ahmed, Md. E. Salama and D.Md.F. Darwesh. 2012. Production of salinity tolerant tilapia through interspecific hybridization between Nile tilapia (*Oreochromis niloticus*) and red tilapia (*Oreochromis* sp.).African Journal of Agricultural Research, 7(19): 2955-2961.

Falter, U. 1987. Description des patrons de coloration chez *Oreochromin niloticus* (L.) (Teleostei: Cichlidae). Annales de la Societe Royale de ZoologieBelge, 117:201-219.

Guerrero III, R.D., L.A. Guerrero and R.G. Cornejo. 1996. Tilapia breeding and seed production for brackishwater culture in the Philippines. p. 159-162. *In*: C.L. Marte, G.F. Quinitio and A.C. Emata (Eds.). Proceedings of the Seminar-Workshop on Breeding and Seed Production of Cultured Finfishes in the Philippines.SEAFDEC Aquaculture Department. Tigbauan, Iloilo, Philippines. p. 174.

Hamzah, A., N.H. Nguyen, R.W. Ponzoni, B.N Kamaruzzaman and B. Subha.2008.Performance and survival of three red tilapia strains (*Oreochromis* spp.) in pond environment in Kedah State, Malaysia. p. 199-211. *In*: H. Elgobashy, K. Fitzsimmons and A.S. Diab (editors). From the Pharaohs to the Future.Proceedings of 8th International Symposium on Tilapia in Aquaculture.Cairo, Egypt. p. 1447.

Kohinoor, A.H.M., P.C. Modak, and M.G. Hussain. 1999. Growth and production performance of red tilapia and Nile tilapia *(Oreochromis niloticus*L.) under low-input culture system. Bangladesh Journal of Fisheries Research, 3(1): 11-17.

Koolhaas, J.M., S.M. Korte, S.F De Boer, C.G. Van Der Vegt, H. Hopster, I.C. De Jong, M.A.W. Ruis and H.J Blokhuis. 1999. Coping styles in animals: current status in behavior and stress-physiology. Neuroscience and Biobehavioral Reviews, 23:925–935.

Lehtonen, T.K., P.A. Svensson and B.B.M. Wong. 2016. The influence of recent social experience and physical environment on courtship and male aggression. BMC Evolutionary Biology 16:18.

Lovshin, L.L. 2000. Criteria for selecting Nile tilapia and red tilapia for culture.Information Management and Networking Component. CRSP Research Reports.Pond Dynamics/Aquaculture Collaborative Program. Oregon State University. Corvallis, Oregon, USA. p. 49-57.

Nowicki, J.P., G.M. Miller and P.L. Munday. 2012. Interactive effects of elevated temperature and CO_2 on foraging behavior of juvenile coral reef fish. Journal of Experimental Marine Biology,412: 46-51.

Romana-Eguia, M. and R.V. Eguia. 1998. Growth of five Asian red tilapia strains in saline environments. Aquaculture, 173: 161–170.

Nguyen, T.N. and D.A. Davis. 2009. Evaluation of alternative protein sources to replace fish meal in practical diets for juvenile tilapia, (*Oreochromis* spp.). Journal of World Aquaculture Society,40(1): 113 -121.

Nguyen, N.H., R.W. Ponzoni, N. Pongthana, A. Hamzah and H.Y. Yee. 2011. Genetic improvement programs for Red tilapia (*Oreochromis* spp.) in Asia. Retrieved from http://www.worldfishcenter.org on October 12, 2016.

Pankhurst, N.W. and H.R. King. 2010. Temperature and salmonid reproduction:implications for aquaculture. Journal of Fish Biology,76: 69–85.

O'Connor, K.I., N.B. Metcalfe and A.C. Taylor. 2000. Familiarity influences body darkening in territorial disputes between juvenile salmon. Animal Behaviour, 59: 1095-1101.

Øverli, Ø., W.J. Korzan, M. Watt, G.L. Forster, K.J. Renner, E.H. Glund, S. Winberg, B.A. Barton, C.H. Summers, H. Bolligand E. Øverli. 2004. Stress coping style predicts aggression and social dominance in rainbow trout. Hormones and Behavior, 45: 235– 241.

Popma, T. and M. Masser. 1999. Tilapia life history and biology. Southern Regional Aquaculture Center. Stoneville, Mississippi. 4 p.

Popma, T.T. and L.L. Lovshin. 1996. Worldwide prospects for commercial production of tilapia. International Center for Aquaculture and Aquatic Environments.Retreived from http://www.aces.edu on November 10, 2016. 10.

Rahman, S.A., H. Zambry, S. Basha, S. Kamarzaman and A.J.K. Chowdhury. 2013. The potential role of red tilapia (*Oreochromis niloticus*) scales: allergic reaction test in mice. Journal of Applied Pharmaceutical Science, 3(10): 45-50.

Reich, L., J. Don and R.R. Avtalion. 1990. Inheritance of the red color in tilapias. Genetica, 80: 195-200.

Roque, A. 2015. Top Luzon University seeing red in 'tilapia'. Retrieved from www.Inquirernews.comonNovember 3, 2016.

Sloman, K.A., K.M. Gilmour, A.C. Taylor and N.B. Metcalfe. 2000. Physiological effects of dominance hierarchies within groups of brown trout, *Salmo trutta* held under simulated natural conditions. Fish Physiology and Biochemistry. 22: 11-20.

Suter, H.C. and F.A. Huntingford. 2002. Eye color in juvenile Atlantic salmon: effects of social status, aggression and foraging success.Journal of Fish Biol., 61: 606-614 .

Tantarpale, V.T., S.H. Ratod and S. Kapil. 2012. Temperature Stress on Opercular Beats and Respiratory Rate of Freshwater Fish *Channa punctatus*. International Journal of Scientific and Research Publications, 2(12): 1-5.

Tauli, M.P. 2013. The association of eye color pattern and ventilation rate on social dominance insulin-like growth factor-1 gene expression in Nile tilapia (*Oreochromis niloticus*L.). Undergraduate Thesis. Central Luzon State University. Philippines. 51 p.

Templonuevo R.M.C. and E.M. Vera Cruz. 2016. Responses of Red Nile Tilapia (*Oreochromisniloticus* L.) subjected to social and confinement stresses. The CLSU International Journal of Science and Technology.Volume 1, No. 2: 7–14. pp. 8-14.

Vera Cruz, E.M. and C.L. Brown. 2007. The influence of social status on the rate of growth, eye color pattern and insulin-like growth factor-I gene expression in Nile tilapia, *Oreochromisniloticus*. Hormones and Behavior, 51: 611-619.

Volpato, G.L., A.C. Luchiari, C.R.A. Duarte, R.E. Barreto and G.C. Ramanzini. 2003. Eye color as an indicator of social rank in the fish Nile tilapia. Brazilian Journal of Medical and Biological Research, 36: 1659-1663.

Watanabe, W.O., D.H. Ernst, B.L. Olla, and R.I. Wicklund. 1989. Aquaculture of red tilapia*(Oreochromis sp.)*in marine environments: state of the art. Aquaculture,46: 487-498.

www.pcaarrd.dost.gov.ph/home/portal/index.php/quick-information-dispatch/2111