TILAPIA REFERENCES

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Summary

Tilapia species and their hybrids are receiving consideration for culture in Ontario. High growth and reproductive rates, hardiness in low oxygen and high-density growout conditions, low-cost plant-protein based diets and a strong market potential make tilapias a promising species for culture in heated-water recirculating systems. The following is a brief listing of research publications, popular press articles and consultants' reports which should be useful to anyone wishing to learn more about tilapia. Published research papers can be accessed through most University libraries. Any questions concerning this reference listing can be directed to the Aquaculture Centre, University of Guelph, 519-824-4120 ext. 52689.

General

1. Anon. 1980. The biology and culture of tilapias. Proceedings of the International Conference on the Biology and Culture of Tilapias, September 2-5, 1980, Bellagio, Italy.
2. Chettleburgh, P. 1991. Simplot Savvy. Northern Aquaculture. 7:29.
3. Fishelson, L. and Z. Yaron (ed.) 1983. International symposium in tilapia in Aquaculture. Proceedings. Nazareth, Israel, May 8-13. 624 p.
4. ICLARM. 1984. Tilapia - The Aquatic Chicken. International Centre for Living Aquatic Marine Resources Newsletter. 7(1): 1-17.
5. Picchietti, M. 1991. An american tilapia survivor speaks out. Aquaculture Magazine 17(6): 55-62.
6. Pullin, R. 1985. Tilapias - Everymans fish. Biologist 32: 84-92. Pullin, R.S.V., T. Bhukaswan, K. Tonguthai, and J.L. MacLean (ed.). 1988. The Second International Symposium on Tilapia in Aquaculture. ICLARM Conference Proceedings 15. 623 pp. Department of Fisheries, Bangkok, Thailand, and International Center for Living Aquatic Resources Management, Manila, Phillipines. (ISBN 971-1022-58-3)
7. Rezeau, M. 1994. Tilapia culture: January 1988 - November 1993. Quick Bibliography Series QB 94-07. National Agricultural Library. U.S. Dept. of Agriculture, Beltsville, MD, USA. 9 p.

8. Stickney, R.R. 1986. Culture of nonsalmonid freshwater fishes. CRC Press Inc., Boca Raton, FL., U.S.A., "Tilapia" pp. 57-72.
9. Stickney, R.R. 1994. Tilapia Update. World Aquaculture 25(3): 14-21.
10. Young, A.T. 1991. Tilapia culture: January 1979 - September 1990. Quick Bibliography Series QB 89-12. National Agricultural Library. U.S. Dept. of Agriculture, Beltsville, MD, USA. 16 p.

Marketing and Economics

1. Anon. 1993. Tilapia named fish of the year. Northern Aquaculture 9: 18.
2. Clement, S., and R.T. Lovell. 1994. Comparison of processing yield and nutrient composition of cultured Nile tilapia *(Oreochromis niloticus)* and channel catfish *(Ictalurus punctatus)*. Aquaculture 119: 299-310.
3. Harvey, D.J. 1992. Tilapia: Interest in Tilapia Production Continues Strong. Aquaculture Situation and Outlook Report, AQUA-9, U. S. Department of Agriculture. pp. 9-10.
4. Harvey, D.J. 1993. Tilapia: Domestic Production to Continue Expanding. Aquaculture Situation and Outlook Report, AQUA-10, U.S. Department of Agriculture. pp. 12-13.
5. Reddy, N.R., C.L. Schreiber, K.S. Buzard, G.E. Skinner, and D.J. Armstrong. 1994. Shelf life of fresh tilapia fillets packaged in high barrier film with modified atmospheres. Journal of Food Science 59: 260-264.
6. Sample, W.D. 1992. Tilapia culture in the United States: What are the prospects? Aquaculture Magazine 18(5): 75-76.
7. Simon, Y. 1992. Culture and marketing of tilapia in Israel. Aquaculture Magazine 18: 32-45.
8. Stechey, D.P. 1990. Opportunities for enhanced development of commercial aquaculture in Ontario: A technological and economic analysis of alternative fish species. Ontario Ministry of Agriculture and Food. 129 pp.

Husbandry and Production Systems

1. Balarin, J.D. and R.D. Haller. 1982. The Intensive Culture of Tilapia in Tanks, Raceways and Cages. *In*: Muir, J.F. and R.J. Roberts (editors). Recent Advances in Aquaculture. Volume 1 pp. 265-355.
2. Bardach, J.E., J.H. Ryther, and W.O. McLarney. 1972. Aquaculture - The Farming and Husbandry of Freshwater and Marine Organisms. John Wiley & Sons, NY., pp. 350-384.
3. Boyle, W.A., D.E. Seawright, R.G. Nielsen, G.E. Bledsoe, and G.M. Pigot. 1993. Model preliminary engineering study for a tilapia aquaculture facility using geothermal water. *In:* Wan, J-K (Editor). Techniques for Modern Aquaculture. Proceedings of an Aquacultural Engineering Conference, June 21-23, 1993, Spokane, WA, U.S.A., American Society of Agricultural Engineers, St. Joseph, MI, U.S.A., pp. 193-203.
4. Dambo, W.B., and K.J. Rana. 1992. Effect of stocking density on growth and survival of *Oreochromis niloticus* (L.) fry in the hatchery. Aquculture and

Fisheries Management 23: 71-80.
5. McGinty, A.S. and J.E. Rakocy. 1989. Cage Culture of Tilapia. Southern Regional Aquaculture Center Publication No. 281. 4 pp.
6. Paessun, M. and R. Allison. 1984. Maximizing tilapia production in recirculating systems by sequential rearing. Aquaculture 42: 185-189.
7. Pierce, B. 1980. Production of hybrid tilapia in indoor aquaria. Progressive Fish-Culturist 42: 233-234.
8. Plaia, W.C. 1987. A computerized environmental monitoring and control system for use in Aquaculture. Aquacultural Engineering 6: 27-38.
9. Provenzano, A. and J. Winfield. 1987. Performance of a recirculating fish production system stocked with tilapia hybrids. Aquacultural Engineering 6: 15-26.
10. Rakocy, J.E. 1989. Tank Culture of Tilapia. Southern Regional Aquaculture Center Publication No. 282. 4 pp.
11. Rakocy, J.E. and A.S. McGinty. 1989. Pond Culture of Tilapia. Southern Regional Aquaculture Center Publication No. 280. 4 pp.
12. Sadek, S., H. Kallafalah, and F. Adell. 1992. Tilapia (*Oreochromis niloticus*) biomass yield in a commercial farm using circular tanks. Journal of Applied Ichthyology 8: 193-202.
13. Springborn, R.R., A.L. Jensen, W.Y.B. Chang and C. Engle. 1992. Optimum harvest time in aquaculture: an application of economic principles to a Nile tilapia, *Oreochromis niloticus* (L.), growth model. Aquaculture and Fisheries Management 23: 639-647.
14. Subasinghe, R.P., and C. Sommerville. 1992. Effects of temperature on hatchability, development and growth of eggs and yolksac fry of *Oreochromis mossambicus* (Peters) under artificial incubation. Aquaculture and Fisheries Management 23: 31-39.
15. Suresh, A. and C. Lin. 1992. Effect of stocking density on water-quality and production of red tilapia in a recirculated water-system. Aquacultural Engineering 11: 1-22.
16. Suresh, A. and C. Lin. 1992. Tilapia culture in saline waters - A review. Aquaculture 106: 201-226.
17. Teichert-Coddington, D. and B.W. Green. 1993. Tilapia yield improvement through maintenance of minimal oxygen concentrations in experimental grow-out ponds in Honduras. Aquaculture 118: 63-71.
18. Torrans, L. and A. Hiott. 1990. Effects of broodstock density on production of bait- or forage-sized blue tilapias. Progressive Fish-Culturist 52: 9-14.
19. Zohar, G., U. Rappaport, and S. Sarig. 1985. Intensive culture of tilapia in concrete tanks. Bamidgeh 37: 103-111.

Reproduction and Genetics

1. Al-Ahmad, T.A., M. Ridha and A.A. Al-Ahmed. 1988. Reproductive performance of the tilapia *Oreochromis spirulis* in seawater and brackish groundwater. Aquaculture 73:323-332.
2. Behrends, L.L., J.B. Kingsley and M.J. Bulls. 1990. Cold tolerance in maternal

mouthbreeding tilapias: phenotypic variation among species and hybrids. Aquaculture 85: 271-280.
3. Chao, N.H., W.C. Chao, K.C. Liu and I.C. Liao. 1987. The properties of tilapia sperm and its cryopreservation. Journal of Fish Biology 30: 107-118.
4. Eknath, A.E., M.M. Tayamen, M.S. Palada-de Vera, J.C. Danting, R.A. Reyes, E.E. Dionisio, J.B. Capili, H.L. Bolivar, T.A. Abella, A.V. Circa, H.B. Bentsen, B. Gjerde, T. Gjedrem, and R.S.V. Pullin. 1993. Genetic improvement of farmed tilapias: the growth performance of eight strains of *Oreochromis niloticus* tested in different farm environments. Aquaculture 111: 171-188.
5. Huang, C.M., S.L. Chang, H.J. Cheng and I.C. Liao. 1988. Single gene inheritance of red body colouration in Taiwanese red tilapia. Aquaculture 74: 227-232.
6. Hulata, G., G.W. Wohlfarth, H. Karplus, G.L. Schroeder, S. Harpez, A. Halevy, S. Rothbard, S. Cohen, I. Isreal, and M. Kavessa. 1993. Evaluation of *Oreochromis niloticus x O. aureus* hybrid progeny of different geographical isolates reared under varying management regimes. Aquaculture 115: 253-271.
7. Hussain, M.G., A. Chatterji, B.J. McAndrew and R. Johnstone. 1991. Triploidy induction in Nile tilapia, *Oreochromis niloticus L.* using pressure, heat and cold shocks. Theoretical and Applied Genetics 81: 6-12.
8. Kronert, U., G. Horstgen-Schwark and H.J. Langholz. 1989. Prospects of selecting for late maturity in tilapia (*Oreochromis niloticus*) I. Family studies under laboratory conditions. Aquaculture 77: 113 - 121.
9. Mires, D. 1985. Genetic problems concerning the production of tilapia in Israel. Bamidgeh 37: 51-53.
10. Paladadevera, M., and A. Eknath. 1993. Predictability of individual growth-rates in tilapia. Aquaculture 111: 147-158.
11. Rana, K. 1988. Reproductive biology and the hatchery rearing of tilapia eggs and fry. *In:* Muir, J.F., and Roberts, R.J. (Editors). Recent Advances in Aquaculture, Vol. 3, Timber Press, Portland, OR., U.S.A. pp. 343-406.
12. Rana, K. and B. McAndrew. 1989. The viability of cryopreserved tilapia spermatozoa. Aquaculture 76: 335-345.
13. Tave, D. 1990. Genetics and breeding: Cold tolerance in tilapia. Aquaculture Magazine 16: 86.
14. Tave, D. 1990. Supermale Tilapia. Aquaculture Magazine 16(2): 69-72.
15. Trombka, D., and R. Avtalion. 1993. Sex determination in tilapia - a review. Bamidgeh 45: 26-37.
16. Varandaraj, K. 1989. Feminization of *Oreochromis mossambicus* by the administration of diethylstilbestrol. Aquaculture 80: 337-341.
17. Varandaraj, K., S.S. Kumari, and T.J. Pandian. 1994. Comparison of conditions for hormonal sex-reversal of Mozambique tilapias. Progressive Fish-Culturist 56: 81-90.
18. Varandaraj, K. and T.J. Pandian. 1990. Production of all-female sterile-triploid *Oreochromis mossambicus*. Aquaculture 84: 117-123.
19. Vera Cruz, E.M., and G.C. Mair. 1994. Conditions for effective androgen sex reversal in *Oreochromis niloticus* (L). Aquaculture 122: 237-248.
20. Wohlfarth, G.W., S. Rothbard, G. Hulata and D. Szweigman. 1990. Inheritance of red body coloration in Taiwanese Tilapias and in *Oreochromis massambicus*.

Aquaculture 84: 219-234.

Nutrition and Feeding

1. Boonyaratpalin, M., and N. Unprasert. 1989. Effects of pigments from different sources on colour changes and growth of red *Oreochromis niloticus*. Aquaculture 79:375 - 380.
2. Clark, J.H., W.O. Watanabe, D.H. Ernst, R.I. Wicklund and B.L. Olla. 1990. Effect of Feeding Rate on Growth and Feed Conversion of Florida Red Tilapia Reared in Floating Marine Cages. Journal of the World Aquaculture Society 21(1): 16-24.
3. Edwards, P., C. Pacharaprakiti, C. Polprasert, V. Rajput and S. Suthirawut. 1983. Compost as fish feed, a practical application of ditritivory for the cultivation of tilapia. Aquaculture 32: 409-413.
4. El-Sayed, M., and D.L. Garling. 1988. Carbohydrate-to-lipid ratios in diets for *Tilapia zilli* fingerlings. Aquaculture 73: 143-156.
5. El-Sayed, A.M., and S. Teshima. 1992. Protein and energy requirements of Nile tilapia, *Oreochromis niloticus*, fry. Aquaculture 103: 55-63.
6. Hepher, B., I.C. Liao, S.H. Cheng and C.S. Hsieh. 1983. Food utilization by red tilapia - Effects of diet composition, feeding level and temperature on utilization efficiencies for maintenance and growth. Aquaculture 32: 255-275.
7. Jackson, A., B. Capper and A. Matty. 1982. Evaluation of some plant-proteins in complete diets for the tilapia *Sarotherodon mossambicus*. Aquaculture 27: 97-109.
8. McVey, E.M. 1992. Feeds and Feeding of Tilapia (bibliography 1990 - 1992). Aquaculture Information Center, National Agricultural Library, Beltsville, MD, USA. 3 p.
9. Omoregie, E., and F. Ogbemudia. 1993. Effect of substituting fish-meal with palm kernel meal on growth and food utilization of the Nile tilapia, *Oreochromis niloticus*. Bamidgeh 45: 113-119.
10. Roem, A.J., R.R. Stickney and C.C. Kohler. 1990. Vitamin requirements of blue tilapias in a recirculating water system. Progressive Fish-Culturist 52: 15-18.
11. Santiago, C., and R. Lovell. 1988. Amino-acid requirements for growth of Nile tilapia. Journal of Nutrition 118: 1540-1546.
12. Santiago, C.B., and O.S. Reyes. 1993. Effects of dietary lipid source on reproductive performance and tissue lipid levels of Nile tilapia *Oreochromis niloticus* (Linnaues) broodstock. Journal of Applied Ichthyology 9: 33-40.
13. Satoh, S., T. Takeuchi and T. Watanabe. 1987. Requirement of tilapia for alpha-tocopherol. Bulletin of the Japanese Society for Science and Fisheries 53(1): 119-124.
14. Satoh, S., T. Takeuchi and T. Watanabe. 1984. Studies on nutritive-value of dietary lipids in fish. 28. Effects of starvation and environmental-temperature on proximate and fatty-acid compositions of *Tilapia nilotica*. Bull. of the Japanese Society of Scientific Fisheries 50(1): 79-84.
15. Shiau, S.Y., and C.Q. Lung. 1993. No dietary vitamin B_{12} required for juvenile tilapia *Oreochromis niloticus* x *O. aureus*. Comparative Biochemistry and Physiology 105A(1): 147-150.

16. Shiau, S.Y., and C.Y. Peng. 1993. Protein-sparing effect by carbohydrates in diets for tilapia, *Oreochromis niloticus x O. aureus*. Aquaculture 110: 321-330.
17. Takeuchi, T., S. Satoh and T. Watanabe. 1983. Studies on nutritive-value of dietary lipids in fish. 26. Requirement of *Tilapia nilotica* for essential fatty-acids. Bulletin of the Japanese Society of Scientific Fisheries 49(7): 1127-1134.
18. Takeuchi, T., S. Satoh and T. Watanabe. 1983. Studies on nutritive-value of dietary lipids in fish. 27. Dietary lipids suitable for the practical feed of *Tilapia nilotica*. Bulletin of the Japanese Society of Scientific Fisheries 49(9): 1361-1365.
19. Viola, S., and Y. Arieli. 1983. Nutrition studies with tilapia (*sarotherodon*). 1. Replacement of fish meal by soybean meal in feeds for intensive tilapia culture. Bamidgeh 35: 9-17.
20. Viola, S., Y. Arieli and G. Zohar. 1988. Animal-protein-free feeds for hybrid tilapia (*Oreochromis nilloticus x O. aureus*) in intensive culture. Aquaculture 75: 115-125.
21. Wang, K., T. Watanabe and T. Takeuchi. 1985. Effect of dietary-protein levels on growth of *Tilapia nilotica*. Bulletin of the Japanese Society of Scientific Fisheries 51: 133-140.
22. Winfree, R., and R. Stickney. 1981. Effects of dietary-protein and energy on growth, feed conversion efficiency and body-composition of *Tilapia aurea*. J. of Nutrition 111: 1001-1012.
23. Zonneveld, N., and R. Fadholi. 1991. Feed-intake and growth of red tilapia at different stocking densities in ponds in Indonesia. Aquaculture 99: 83-94.

Physiology

1. Al-Amoudi, M.M. 1987. Acclimation of commerically cultured *Oreochromis* species to sea water - an experimental study. Aquaculture 65: 333-342.
2. Stickney, R.R. 1986. Tilapia tolerance of saline water: A review. Progressive Fish-Culturist 48(3): 161- 167.
3. Sun, L.T., G.R. Chen and C.F. Chang. 1992. The physiological-responses of tilapia exposed to low-temperatures. Journal of Thermal Biology 17(3): 149-153.
4. Sun, R.Y., and Y.S. Zhang. 1983. The influence of water temperature on the growth of tilapias. Bulletin of Marine Science 33(3): 782.
5. Watanabe, W.O. and C.M. Kuo. 1985. Observations on the reproductive performance of nile tilapia (*Oreochromis niloticus*) in laboratory aquaria at various salinities. Aquaculture 49: 315-323.
6. Watanabe, W.O., C.M. Kuo and M.C. Huang. 1985. The ontogeny of salinity tolerance in the tilapias *Oreochromis aureus*, *O. niloticus*, and an *O. mossambicus* x *O. niloticus* hybrid, spawned and reared in freshwater. Aquaculture 47: 353-367.

Sources of Tilapia

1. The Annual Buyers Guide published by Aquaculture Magazine has a comprehensive listing of North American sources of the different species of tilapias and their hybrids. Copies of the Annual Buyers Guide are available in the Aquaculture Reading Centre or contact Aquaculture Magazine, PO Box 2329,

Asheville, North Carolina, USA, 28802 or call 704-254-7334.

Sources of Other Information

American Tilapia Association
Midwest Aquaculture Learning Centre
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