

OXYGEN DYNAMICS, AND FISH GROWTH IN AQUACULTURE

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Bioenergetic analysis of red drum (*Sciaenops ocellatus*) growth in aquaculture ponds (Garces 1991) suggested a marked effect of dissolved oxygen concentration (DO) on feed consumption: The proportion of maximum daily ration achieved, F, was deduced to vary as a linear function of DO, over the interval 2.0 to 5.5 ppm, according to the relation

$$F = 0.17 + 0.14 \cdot \text{DO}.$$

Incorporation of this relation into a conventional bioenergetic growth model permitted very accurate simulation of fish weight versus time, in a variety of ponds and over periods up to one year (average r-square = 0.98, for all 14 trials).

This result motivated development of a technique for monitoring metabolic rates of red drum in intensive aquacultural production systems. Central to this technique is a model proposing that oxygen-uptake rates of fish kept at high density in open systems can be estimated from a mass balance on oxygen supply and demand. The model was validated in a series of experiments (Oborny 1993) culminating in tests involving 115,000-L commercial production systems, with fish biomasses up to 60 g/L. These tests compared the proportion of apparent oxygen consumption to the proportion of fish biomass remaining, as fish were removed in two steps from each of two systems. In one system, 80 % of the fish consumed 73 % of the oxygen consumed by all the fish. The second system yielded 29 % of oxygen consumption for 33 % of fish weight. The apparent metabolic rates of the 30-200-g red drum in these large systems (equipped with liquid-oxygen injection and sophisticated bioreactors) ranged from 0.54 to 0.69 mgO₂g⁻¹h⁻¹.

References

- Garces B., H.A. 1991. Observed and modeled growth of red drum in aquacultural ponds in the Republic of Panama. Ph.D. dissertation, Texas A&M University, College Station, Texas, USA. 86 p.
- Oborny, E.L., Jr. 1993. Open-system respirometry in intensive aquaculture: Model validation and application to red drum (*Sciaenops ocellatus*). M.S. thesis, Texas A&M University, College Station, Texas, USA. 62 p.