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Physiological insights for aquaculture diversification: Swimming capacity and efficiency, and metabolic scope for activity in cojinoba *Seriolella violacea*

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Abstract:

Aquaculture diversification is important for providing sustainable sources of food fish amidst changing environments, pathogens, economies, and market demand. Particularly for newly cultured species where information may be limited, optimization of culture practices relies on an understanding of the physiology and ecology of a species. The cojinoba (*Seriolella violacea*; Centrolophidae), a coastal pelagic marine fish, is a species of growing importance for aquaculture production in South America. Although methods for breeding and larval to juvenile rearing have been established, little is known about the physiology of this species. Therefore, measures of metabolism, swimming capacity and efficiency, red:white (R:W) muscle ratios, and associated aerobic and anaerobic biochemical parameters, such as plasma glucose and lactate, and muscle enzyme activities (i.e., pyruvate kinase, citrate synthase, electron transport system [ETS]), were measured. For cojinoba at 15 °C with mean body length (BL; total length) of 22 cm, critical swimming velocity (U_{crit}) was approximately 80 cm/s or 3.8 BL/s, and optimal swimming velocity (U_{opt}) was 50 cm/s or 2.3 BL/s. Aerobic scope for metabolism was approximately 300 mg O₂/kg/h, with M_{O₂} max 3.4 fold greater than standard metabolic rate. Swimming was facilitated by linear increases in tail beat frequency until burst and glide swimming initiated near U_{crit} . At low velocities, large (~20% BL) pectoral fins were used for propulsion and maneuverability/maintaining equilibrium; beat frequency diminished rapidly with increasing velocity. Red:white muscle ratios at 50% BL and 75% BL (caudal peduncle) were comparable to other ectothermic species, with a greater proportion of red muscle in the caudal peduncle presumably corresponding to facilitation of sustained pelagic swimming. Plasma glucose and lactate were elevated at U_{crit} by 20% and 45% respectively, indicating mobilization of anaerobic energy sources at fatigue. Aerobic enzyme activities were much higher in red muscle, the ratio of anaerobic:aerobic enzyme activity was higher in white muscle, and ETS activities decreased at fatigue in both red and white muscle. The cojinoba has a moderate metabolic rate compared to other pelagic species, displays shoaling behavior, is maneuverable at low velocities due to pectoral fin use, but has optimal swimming efficiencies at higher velocities. These factors are beneficial for designing culture systems to promote exercise benefits for growth and welfare.

Keywords: aquaculture, swimming capacity, plasma glucose, metabolic rate, aerobic enzymes, *Seriolella violacea*