Androgens stimulate sex change in protogynous grouper, *Epinephelus coioides*: spawning performance in sex-changed males

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Abstract

We examined the efficacy of androgens (1.0 mg/kg body mass), testosterone (T), 11-ketotestosterone (11-KT), 17α-methyltestosterone (MT), testosterone propionate (TP) or androgen mixture (T, MT and TP in an equal ratio), for induction of sex change in protogynous orange-spotted grouper, *Epinephelus coioides*. The spawning performance in sex-changed males was also investigated. MT and androgen mixture at a dose of 1.0 mg/kg BW induced a sex transition and completion of spermatogenesis up to the functional male phase. The androgen mixture was most effective. Significantly, higher plasma T levels were found in MT and androgen mixture groups compared to control and other androgen implantation (T, TP or 11-KT) groups. We found that plasma levels of estradiol-17β (E2) or 11-KT were not different among treated groups. Sex-changed males could successfully fertilize mature eggs. Fertilization and hatching rates were of 23.5–70.4% and 8.4–44.6%, respectively. The data demonstrated that induction of sex change by exogenous androgens in groups could apply to the aquaculture field for seed production.

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1. Introduction

Groupers of the genus *Epinephelus* are widely distributed throughout the tropical and subtropical waters of the world. They are commercially important and highly regarded as a favourite marine food fish. The groupers possess excellent biological characteristics: they are fast-growing, disease resistant and suitable for culture. Grouper farming appears to have great promise, and coastal cage culture has unenviable potential for continued development. However, growth of the grouper culture industry has been hindered by an unreliable and limited supply of seed. Mass production of grouper fry from hatcheries under controlled reproduction, in which simultaneous availability of mature broodstock of both sexes is required, will certainly be the key to the success of industry growth.

The groupers are protogynous teleosts (Tan and Tan, 1974; Chen et al., 1980; Brusle-Sicard et al., 1992; Sadovy and Colin, 1995), and limited information is available with regards to the natural sex change of these grouper species. In the estuarine grouper, *Epinephelus tauvina*, the transition from female to male begins at the age of 7 years, and the proportion of sex-inverted males increases...