Sex Reversal of Tilapia: 17α-Methyltestosterone Dose Rate by Environment and Efficacy of Bull Testes

Interim Work Plan, Honduras, Study 4

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Introduction

Sex reversal of newly hatched tilapia generally is accomplished via oral administration of 17α-methyltestosterone (MT), which has been incorporated into a starter fish feed at 60 mg MT/kg feed (Popma and Green, 1990). Although the use of the 60 mg MT/kg feed dose consistently yields populations comprised of less than 5% females (i.e., > 95% males), this has not been shown to be the optimal dose. Other investigators have reported sex reversal of tilapia at dose rates less than 60 mg MT/kg feed (Guerrero, 1975; Tayamen and Shelton, 1978; McGeachin et al., 1987; Jo et al., 1988; Varadaraj and Pandian, 1989); however, results from some of these studies are inconsistent, and it is difficult to separate treatment environment effects. Thus, it is necessary to identify the optimal dose of MT for consistent, successful sex reversal in a variety of treatment environments.

Naturally occurring sources of testosterone may be an alternative to using a synthetic androgen, which also is an anabolic steroid, for tilapia sex reversal. Haylor and Pascual (1991) reported successful tilapia sex reversal using ram testes as a source of dietary testosterone. Bull testes are a by-product of the beef industry in the US and are a potential source of dietary testosterone for tilapia sex reversal.

The objectives of this research were to:

1) determine the efficacy of different dosage rates of MT for sex reversal of fish treated in different environments; and
2) evaluate the potential of freeze-dried bull testes as a dietary source of testosterone for tilapia sex reversal.

Materials and Methods

Newly hatched Nile tilapia (*Oreochromis niloticus*) were stocked at 8 fry/l into 80-l glass aquaria located inside a hatchery building or into hapas (45-l volume) suspended in 20-m^3 outdoor concrete tanks located at the Fisheries Research Unit, Alabama Agricultural Experiment Station, Auburn University, AL. Fry were stocked on 1 August 1995 and harvested after a 28-d treatment period. Subsamples of fry from each treatment unit were

transferred to hapas suspended in 20-m^3 outdoor concrete tanks for nursery rearing to approximately 5-g size. Once fingerlings attained an average weight of 5 grams, they were sacrificed, the gonads were excised, and sex was determined according to the aceto-carmine squash method (Guerrero and Shelton, 1974).

Trout chow (42% protein) was the carrier for MT, which was incorporated into the feed at 0, 10, 20, 30 or 40 mg MT/kg of feed. The appropriate quantity of MT was dissolved in 500 ml of 95% ethanol/kg feed, and mixed with the powdered feed. Ethanol only was mixed with feed for the 0 mg MT/kg feed treatment. Ethanol was evaporated from the alcohol-feed mixture, and the dried feed was refrigerated until use. Fry in each treatment were fed at 20% body weight during week one; the daily ration was divided into four meals. Feed rate was decreased by 2.5%/wk during weeks two to four and adjusted weekly based on results of weekly population samples.

Frozen bull testes were obtained from a meat packing plant in Montgomery, AL. Individual testes were skinned, sliced, freeze-dried, ground, and mixed with trout chow either in a 1:1 or 1:3 freeze-dried testes:trout chow ratio. Mixed feed was refrigerated until feeding. The concentration of testosterone per gram of freeze-dried testes was determined by radioimmuno assay (Rahe, personal communication).

Results

The use of freeze-dried bull testes (BT) as a source of testosterone was not effective in producing tilapia populations of 95% or greater males. The percentage of males (54%) in populations fed a ration containing 25% BT did not differ from non-treated populations (52.4%). The percentage males (64.8%) obtained when BT composed half of the ration was significantly greater than non-treated populations; however, the percentage males obtained was too low for such a ration to be considered practical for the production of male tilapia.

Indoor and outdoor treatments did not affect the ability of 17α-methyltestosterone to alter the sex ratio of tilapia. Greater than 97% male populations were obtained at dose rates of 15, 30, 45 and 60 mg MT /kg of diet when fish were treated in indoor aquaria or outdoor hapas.

After the 28-d MT treatment period, fry mean total lengths ranged from 32.8 to 39.6 mm and 40.7 to 44.3 mm for fry treated in aquaria (indoors) and hapas (outdoors), respectively. Average respective final weight ranges were 0.7 to 1.0 and 1.2 to 1.9 g/fry. Fry survival in both environments was low and ranged from 16.7 to 27.7% and 25.7 to 43.6% in aquaria (indoors) and hapas (outdoors), respectively.

Fry fed feed containing bull testes were 55.6 and 59.7 mm total length for 1:1 and 1:3 ratio feeds, respectively, following the 28-d treatment period. Mean final weights were 2.0 and 0.7 g/fry for 1:1 and 1:3 ratio feeds, respectively, which undoubtedly reflected the difference in respective survival during treatment (28.3 versus 69.2%).

Discussion

Popma and Green (1990) discussed how the presence of 3 to 5% females in tilapia production ponds can result in excessive reproduction and reduced growth. The testosterone level of the freeze-dried bull testes was found to be 11.4 µg/g (Rahe, personal communication). When mixed half and half with the commercial ration, the effective hormone dose was reduced to approximately 5.7 mg/kg of diet. If given as the sole component of the ration, BT containing 11.4 µg/g may give an acceptable percentage of males. Jay-Yoon et al. (1988) obtained 97% male *O. niloticus* populations feeding 10 mg of 17α-methyltestosterone/kg of ration. Pandian and Varadaraj (1988) were able to produce a 100% male population of *O. mossambicus* using 5 mg of 17α-methyltestosterone/kg of diet.

Anticipated Benefits

Bull testes were demonstrated to be an ineffective source of testosterone for sex reversal of tilapia. Methyltestosterone appeared to be efficacious at all dose rates tested; however, the dose-response evaluation was complicated because of low survival. Treatment environment also does not affect the efficacy of 17α-methyltestosterone treatment for sex reversal.

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