Maximum Voluntary Feed Intake and Growth of Nile Tilapia Fry as a Function of Water Temperature

Work Plan 7, Africa Study 4

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Introduction

Production of monosex tilapia fingerlings is often the primary constraint to broad adoption of food fish production strategies evaluated through the PD/A CRSP. Perhaps the most widely used method for production of monosex fingerlings is masculinization of fry by the use of hormone-treated feed (sex reversal). In recent years much PD/A CRSP research has focused on this process.

Influence of water temperature on dynamics of tilapia growth has implications for many aspects of tilapia culture, including sex reversal. Growth rate has long been suspected to influence timing of gonadal differentiation and efficacy of sex reversal, but little research data is currently available. However, before these investigations can be conducted, more information is needed on appetite and growth response of tilapia fry grown at temperatures commonly found in sex-reverse culture situations. Additionally, information on maximum feed consumption of fry as a function of temperature is necessary to most efficiently administer the hormone-treated feed. Given growing consumer concern about food safety, the ability to eliminate excess use of hormone is highly desirable.

Maximum voluntary feed intake (satiation) of fry fed a powdered feed cannot be measured using standard techniques. For this study, therefore, maximum voluntary feed intake was defined as the feed rate which growth no longer increased. The desired end result of this study is a set of tables, by temperature, listing satiation feeding rates in percent body weight per day (% bw/d) for fish weighing 15 mg, 25 mg, 50 mg, 75 mg, 100 mg, 200 mg, 300 mg, 400 mg, 500 mg, 600 mg, 700 mg, 800 mg, or 900 mg.

Materials and Methods

This experiment was conducted at the Auburn University Fisheries Research Unit in Auburn, Alabama. One trial was run at each of the following three temperatures: 30°C, 26°C and 22°C. The 30°C and 26°C trials were continued for a period of 28 days, while the 22°C trial lasted 32 days. For each trial, 300 *Oreochromis niloticus* (Egypt strain) fry weighing 16-26 mg (10.7-11.8 mm average length) were stocked into each of 28 45-l aquaria. Fry were counted individually and weighed in groups of 300 to determine average weight. Treatments of four replicates were fed at seven feed rates, ranging from 10-28% bw/d at 30°C, 7-25% bw/d at 26°C and 4-22% bw/d at 22°C (Table 1). Fish were fed Zeigler's tilapia starter control diet (54% protein). Daily feed rations, measured to the nearest 0.01 g, were divided into four approximately equal portions and fish were fed at equally spaced intervals during daylight hours, except on sampling days, when the daily ration was divided into three feedings. Feed rates were adjusted daily, based on actual aquarium population (as counted at each sampling) and anticipated growth rate (assumed to be the same as that exhibited during the previous four-day period). Fish were sampled every four days by counting all fish in each aquarium and weighing them as a group to determine total biomass. Total weight, number of fish and growth over the previous four days were used to determine feed rate for the next four days, which was adjusted daily. Temperatures were checked, and adjusted if necessary, at least four times daily. At all times, temperature remained within 1°C of the desired temperature. Water flow was maintained at a minimum of two exchanges per hour. All aquaria were siphoned regularly to remove uneaten feed and accumulated debris. Dissolved oxygen (DO), total ammonia nitrogen (TAN) and pH were measured regularly at the outfall from the aquaria. Total alkalinity and total hardness were measured at the beginning and end of each trial.

30^{0} Trial 28 days Initial size = 16.1 mg			26^{0} Trial 28 days Inital size = 17.5 mg			22^{0} Trial 32 days Initial size = 25.9 mg		
Feed rate (% bw/day)	Avg. final weight (mg)	Growth (mg/d)	Feed rate (% bw/day)	Avg. final weight (mg)	Growth (mg/d)	Feed rate (% bw/day)	Avg. final weight (mg)	Growth (mg/d)
10	428	14.7	7	179	5.6	4	92	2.1
13	565	19.6	10	285	9.5	7	167	4.4
16	685	23.9	13	366	12.4	10	228	6.3
19	730	25.5	16	421	14.4	13	265	7.5
22	785	27.5	19	463	15.9	16	264	7.4
25	833	29.2	22	496	17.1	19	306	8.8
28	900	31.6	25	531	18.3	22	314	9.0

Table 1. Feed rates, average final weights, and growth of Nile tilapia fry reared for 28-32 days at 30°C, 26°C and 22°C.

Data were analyzed by regression and curve-fitting techniques. A regression equation was determined for fish growth in each aquarium. These equations were then used to find growth rates of the fish in those aquaria at specific sizes. The resulting points were plotted against feed rate to show, for fish of a given size at each temperature, at what feed rate maximum growth occurred. This feed rate would then be considered maximum voluntary feed intake.

Results

Average final weights and growth of fry at each temperature are shown in Table 1. Upon analysis of the data, it became apparent that the highest feed rates used at each temperature did not exceed maximum voluntary feed intake for the smallest sizes of fish. Additionally, fish at the lower feed rates did not reach a size sufficient for adequate comparison with fish fed at the higher rates. Consequently, the data collected so far is insufficient to determine maximum feed consumption for fish at all sizes encountered during the first 28 days of feeding at these temperatures. Further trials are planned to obtain the needed data points.

Anticipated Benefits

Results from this study will contribute to an understanding of appetite and growth response of tilapia fry reared at a wide range of temperatures. This information will enable researchers to investigate the effects of growth rate on timing of gonadal differentiation and the efficacy of sex reversal. It is anticipated that these results will lead to the more efficient use of hormone-treated feed and will help lead to the clearance of 17–α methyltestosterone for this purpose by the U.S. Food and Drug Administration. Tilapia farmers worldwide, and especially those in the United States, will benefit greatly from the clearance of this compound for commercial use.

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