Optimum Temperature and Stocking Density for the Transportation of Tilapia (Oreochromis niloticus) Broodstock in the Semi-arid zone of Nigeria

By

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ABSTRACT

Oreochromis niloticus broodstock of mean weight 32.3g were cropped in the morning with dragnet from a 1ha reservoir and transported in round tanks to the Hatchery complex of the National Institute for Freshwater Fisheries Research where they were stocked into 5m x 5m indoor concrete tanks filled with clean water and with aerators at a density of 4 fish/m². They were acclimated for 5 days and then packaged into 60 liter capacity waterproof bags at the following stocking densities: 60, 80, 100, 120, 140 fish/60 lit bag. Each stocking density had bags with ice blocks and bags without ice blocks in triplicate. The waterproof bags were oxygenated, loaded into quick fitting plastic bowls and transported in a bus from New Bussa to Warra, Kebbi state, a journey of 3 hours. The trip was repeated four times. Percentage survival in bags with ice block were 100% for stocking densities 60, 80, 100 fish/60 lit bag, 95.1% for 120 fish/60 lit bag and 84.7% for 140 fish/60 lit bag (mean temperature 23.5 °C). Mortalities were recorded in all the bags without ice block but the highest survival was in the bag with stocking density 60 fish/60 lit bag (mean temperature 29.2 °C).

INTRODUCTION.

Tilapias are native African fishes that are found all over the world and are of great importance in aquaculture due to their general hardiness, relative fast growth, resistance to disease, tolerance to low water quality, ease of breeding, high palatability etc (Madu *et al*, 1996; Guerrero, 1983; Watanabe *et al*, 1985). *Oreochromis niloticus* is one of the most important Tilapia species. It is suitable for low technology fish farming systems in third world countries and is wide spread in Nigerian fresh waters (Ita, 1991). Experience has shown that the cropping, acclimation and transportation of *O. niloticus* can lead to mass mortality at each stage of the process if adequate care is not taken. Mortality can only be prevented or reduced by developing a good and economical transport system for live fish that minimizes stress on the fish and ensures a high rate of survival. There are two basic systems for transporting fish fry, fingerlings and broodstock the closed system and the open system. The closed system is a sealed container where requirements for survival are self-contained, for example a sealed plastic bag partly filled with water and oxygen. The open system consists of water-filled containers in which the requirements for survival are fully or partially supplied from outside sources, for example a small tank with an aerator stone for long distance delivery of fingerlings or without a aerator stone for short distance delivery (Nandlal and Pickering, 2004).

Transport in waterproof or plastic bags may be the best choice because very small fish and fry may be damaged if transported in large tanks and due to the extreme distances that are sometimes involved it offers economic advantages over standard tank transportation (Swann, 2007). This study seeks to elucidate optimal conditions for the cropping, acclimation and transportation of *O. niloticus* in waterproof bags.

Materials and methods.

The fish was cropped from reservoir 3 (area of 80m x 70 m) at the integrated fish farming unit of the National Institute for Freshwater Fisheries Research (NIFFR), New Bussa and were transported in a 400 litre capacity round tank on a vehicle to the Hatchery unit of NIFFR where they were stocked in 5m x 5m indoor tanks for acclimation. After one week the fish were packaged in thick waterproof bags of average capacity 60 litres, and transported to the buyer at Warra, Ngaski local government area of Kebbi state a journey of three hours.

a. Cropping. Cropping was done with a 15m long drag net. Three cropping temperatures (three treatments) were used and cropping was done in triplicate. The first cropping was done at 8am in the morning with water temperature of 26 °C while the second cropping was done at 12pm in the afternoon (water temperature of 29.1 °C). The third cropping was done at 5pm with water temperature of 33 °C. The reservoir water was put into the round tanks before putting the fish into it. The fish were taken to the hatchery complex (journey of about 5 minutes) and each crop of fish was stocked in 5mx5m indoor tanks (with aerators) filled with clean water (Temperature, 27.8 °C; pH, 7.1; Dissolved oxygen, 5.7 mg/Lit).

b. Stocking and acclimation. Fish of mean weight, 32.3g were selected and stocking densities of 2, 4, 6 and 8 fish per m^2 (in triplicate) were used to determine the optimum stocking density in the 5mx5m indoor tanks. Table 1 shows percentage survival after 1 week.

Four treatments were used to determine survival of fish if mixed stocking is done. This consisted of three indoor tanks (in triplicate) stocked at a density of 4 fish/m^2. Treatment 1 comprised of fish cropped at 8am from water of temperature of 26 °C which was used to stock one indoor tank to full capacity and this served as the control. Two other indoor tanks were stocked to half capacity with fish cropped at 8am. Treatment 2 comprised of fish cropped from water of temperature, 29.1 °C and this was used to make up the stocking density in one of the half capacity indoor tanks. In treatment 3 were fish cropped from water of average temperature, 33 °C and they were used to make up the stocking density in the third indoor tank. Treatment 4 consisted of an indoor tank that was hall filled with fish cropped at 12pm (water temperature, 29.1 °C) and subsequently filled to capacity with fish cropped at 5pm (at average temperature, 33 °C). Table 2 shows percentage survival for the four treatments under mixed stocking after one week. pH and Dissolved oxygen were measured daily and weekly respectively in all the tanks and are shown on table 2. Both experiments were repeated weekly for six weeks.

c. Transportation. 60, 80, 100, 120 and 140 fish of mean weight 32.3g (acclimated for at least one week) were separately packaged in triplicate into waterproof bags of 60 liter water capacity. The bags were sealed at one end and filled with 40 litres of clean water (Temperature, 27.5 °C; pH, 6.9; Dissolved oxygen, 5.5 mg/Lit) and were oxygenated and tied with nylon strings. Water temperatures were taken before the bags were tied and also at the end of the journey at Warra for calculation of average temperatures. Some bags had ice blocks put in them before being oxygenated and closed (average temperature, 23.5°C) while others were transported at average ambient temperature of 29.2 °C. The fish were transported from New Bussa to Warra in a bus. Percentage survival for the three hour journey is shown on table 3. The transportation was done biweekly for two months.

Results and discussion

Percentage survival of *O. niloticus* at different stocking densities is shown on table 1. For fish cropped at 26 °C, survival ranged from 100% at a stocking density of 2 fish/ m^2 to 87.5% at a stocking density of 8 fish/ m^2. For fish cropped at 29.1°C, it ranged form 97.4% to 80.7% while survival ranged from 90.3 to 74.3°C for fish cropped at 33°C,. Single factor ANOVA shows that there's no significant difference ($P>0.05$) between the values obtained for stocking densities 2 and 4 at all temperature values. It shows that survival is generally greater if fish is cropped at a temperature range of 26 29 °C (i.e. in the morning) and then stocked at a density not more than 4 fish/m^2.

Table 1. Percentag e survival (%) at different stocking densities for fish cropped at different temperatures

Stocking densities (n o of fish/m^2)	% survival at 26°C	% survival at 29.1°C	% survival at 33°C
2	100±0.5	97.4±0.8	90.3±1.0
4	100±0.7	95.1±0.3	92.6±1.1
6	95.2±0.7	90.2±1.2	85.9±1.4
8	87.5±1.2	80.7±0.8	74.3±0.2

Table 2 shows the percentage survival if fish cropped at different temperatures are stocked together. Survival ranged from 97% in treatment 1 to 40.7% in treatment 4. It shows that stocking fish cropped at a given temperature into a tank or pond which contains fish that has already stabilized temperature wise may lead to mortalities. This may be due to the disruption of the temperature equilibrium in such a system which leads to stress, thermal shock and subsequent mortality of fish. Single factor ANOVA shows that there's significant difference ($P<0.05$) in the values obtained for all the treatments. Table 2 also shows the mean pH measured for all the treatments and it shows that water became progressively more acidic from treatment 1 to

4.

Table 2. Percentage survival (%) and mean pH of the Treatments

Treatments	Percentage survival (%)	Mean pH
Treatment 1	97±0.6	7.12±0.01
Treatment 2	75.7±1.3	6.98±0.08
Treatment 3	60.2±2.1	6.54±0.11
Treatment 4	40.7±1.5	6.33±0.20

It is obvious from table 3 that transportation of fish at low temperatures significantly decreases mortality due to decreased metabolic rate and respiration (Nandlal, and Pickering, 2004). There's 100% survival of fish transported at an average temperature of 23.5 ^{0}C for all stocking densities except those of 120 fish/60 litre bag and 140 fish/60 litre bag. However, survival ranged from 96.7% at stocking density of 60 to 63.7% at stocking density of 140 fish/60 litre bag if fish is transported at an average temperature of 29.2 ^{0}C (i.e. without ice block).

Table 3. Percentage survival (%) of fish transported in waterproof bags at different stocking densities

Stocking densities (no of fish/60 litre bag)	% survival with ice block (average temperature 23.5 ^{0}C)	% survival without ice block (average temperature 29.2 ^{0}C)
60	100	96.7±0.8
80	100	95.4±1.0
100	100	90.4±0.7
120	95.1±0.8	70.9±1.2
140	84.7±1.1	63.7±1.4

CONCLUSION

Harvesting of fish from fish ponds is better done in the morning (before 12 pm) and it is bad practice to mix fish cropped at different water temperatures together in the same pond or tank as it may result in thermal shock. Also 100 *O. niloticus* (mean weight 32.3g) in a 60 litre capacity oxygenated waterproof bag with water at the 40 liter level can be transported at an average temperature of 23.5^{0}C for three hours without any mortality.

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