Effects of Water Quality Parameters in Transportation of *Oreochromic Niloticus* Fingerlings

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Abstract
In an effort to increase the survival of Oreochromis niloticus fingerlings, a transportation trial of live Oreochromis niloticus fingerlings was stocked at 2 fish/litre. The study was conducted using four transportation containers namely; plastic buckets, open Jerri can, plastic trough and polythene bag. The physio-chemical parameters of the transporting containers were measured to access the changes in water quality before and after transport. Parameters such as temperature, dissolved Oxygen, hydrogen ion concentration and Ammonia among the transporting containers. These may be due to the small replicate, external factors like weather and duration of transport. The highest survival was obtained in plastic bucket and open Jerri can (95%) while the lowest survival was obtained in Plastic trough and Polythene bag (93%).

Keywords: *Oreochromis niloticus, water quality parameters, containers, transportation.*

Introduction

Today we recognize a fish as an aquatic vertebrate with gills, appendages, if present, in the form of fins, and usually a skin with scales of dermal origin (Hickman *et al*., 2011). Fish are at present in high demand in food markets, they are widely consumed in many parts of the world because they possess high protein content, low saturated fat and also contain omega fatty acids known to support good health (Ikem and Egiebor, 2005; Nina and Gunalan, 2012).

Tilapia was named by Andrew Smith, a Scottish zoologist, in 1840 (Eschemeyer, 2007). Tilapia of the genus Oreochromis are a popular species for aquaculture in several regions of the world (Bolarin and Haller, 1982). However, many of the characteristics of tilapias that make them most suitable for farming include general hardiness, ease of breeding, rapid growth rate and the ability to efficiently utilize organic wastes (Stickney *et al.* 1979; Pullin and Lowe- McConnell, 1982; Bolarin and Haller, 1982). Transportation means carrying or moving an object from one point to another. Transportation in aquaculture is movement of fish (fingerlings, juveniles, and adult fish) from a particular point a place to another (Stella *et al*., 2007).

Transporting fish is a very important part of fish culture (Bolorunduro, 2001). Fry and fingerlings must be transported from hatchery to pond for stocking. Brood fish are sometimes transported into the hatchery to spawn. It may even be necessary to transport live harvested fish to the market for sale. Many methods for fish transport have been developed (Bolorunduro, 2001).

Fish are generally transported in containers such as cans of different sizes, pots of ceramic or metal, wooden or metal buckets, vats, barrels, plastic bags, Styrofoam boxes, bottles, jugs, animal skins and bamboo sections. In fact, almost any clean, waterproof container may be used. Certain containers provide good insulation from heat, for example, wood or Styrofoam. Containers like metal or plastic are poor insulators and may have to be wrapped with wet towels or packed with ice to keep temperatures down (Bolorunduro, 2001).

Once fish have been placed in transport container they should be brought to their destination by the quickest possible means that will provide relatively smooth and direct route. This may be by foot, animal cart, bicycle, boat, vehicle, etc. (Madu, 1999).

The ultimate aim of transportation is to provide healthy live fish at the destination (Bolorunduro, 2001).

Transporting live tilapia fish involves handling of a large number of fish into a small quantity of water. Unless this is done properly, water quality deteriorates causing fish mortality (Nandlarl and Pickering, 2004).

Tilapia cannot withstand low dissolved oxygen, high temperature, and high ammonia in the culture system. This makes it difficult to transport tilapia from a far distance (Nandlarl and Pickering, 2004).Unlike *Clarias* species; tilapia cannot be transported without aeration.

The cause of mortality in fish transport generally include depletion of dissolved oxygen in ambient water due to respiration of fish, oxidation and excreted waste; accumulation of free carbon dioxide, sudden fluctuation in temperature, hyper activity and stress due to handling and confined space and physical injuries (Bolorunduro, 1995).

Numerous chemical additives/anaesthetic can be added to the transport water to alleviate several problems associated with transporting fish (Swann, 1993).

Common table salt is widely used in fish transport. It should contain no iodine. The concentration of salts in the blood of most fish is 1 to 1.2 percent. Adding salt to the transport water reduces the mineral difference between the water and fish blood which lessens the effects caused by this osmotic imbalance. Salt is added to make solutions of 0.05 to 1 percent (500 to 10,000 ppm), depending on the species of fish. This is equivalent to 0.4 to 8 pounds of salt per 100 gallons of water. Use the lower rates on freshwater fish (Gary, 1990).

Tilapia is a culturable fish species that grows to maturity within four months. Fish farmers can produce market-size fish at least three or four times a year. The fish does not require high crude protein for growth (Chowdhury, 2008).

Development of gene bank from various zones in Nigeria will enhance the culture of fast growing tilapia. Therefore a better means of transporting this fish from far distances is highly required. Hence the need to research on its transportation to help fish farmers culture better growing tilapia species. This will help to reduce the problem of transporting this fish species.

The main objective of this research is to understand the effect of transportation of live tilapia on the water qualities using different transportation containers.

However, the specific objectives are to:

- **i.** Evaluate the changes in dissolved Oxygen (DO) in ambient water due to the respiration of fish before and after transportation.
- **ii.** Determine the changes in ammonia concentration during fish transportation.
- **iii.** Compare the fluctuations in temperature before and after fish transportation.
- **iv.** Evaluate the changes in hydrogen-ion concentration due to fish transportation.
- **v.** Determine the influence of different transport containers on the water quality

due to fish transportation.

Materials and Methods

Study Area

The study will be carried out at Sebore farms in Mayo Belwa L.G.A of Adamawa state. It is suited between latitude 9, 0500 (93'N) and longitude 12,500 (123'0E) to the equator (National Population Commission of Nigeria, 2011; Adebayo, 1999).

Sebore farms were established in 1982, the farm is located at km 12 Mayo Belwa – Ngurore road. It covers an area of 1500 hectares of land; the farm is involved in integrated modern concept of farming and has grown into exporting her product oversea. The farm has two main dams namely Sebora dam and Chakawa dam which are used in sustaining the farm, the Sebore dam is well known for its aquatic biodiversity and makes it a complete ecosystem (Adekoya *et al*, 2004).

Water Quality Parameters

Water temperature was taken before and after transportation with mercury-in-glass thermometer. Hydrogen ion concentration (pH) was monitored before and after transportation using a pH meter. Sample bottles were washed and used to collect the water samples before loading of the fish (0 hour), after 1:30 hours (termination of transportation). The water samples were fixed using reagent A (MnSO4) and reagent B (Ki and KOH) for dissolve oxygen determination and titration.

Study Duration

The study lasted for a period of 3 months (January-March), samples were collected once every month making a total of three times.

Sample size of experimental fish

A total of 240 *Oreochromis niloticus* was transported using a constructed black 50litre open cut Jerican, Plastic bucket, Plastic trough and Polythene bag. The fish were purchased from Sebore farms in Mayo Belwa. After the purchase, the temperature, pH, dissolved oxygen and CO_2 were measured before transportation and after transportation. All dead fish were removed, counted and recorded and used for the determination of percentage survival.

Stocking Density

The number of fish per unit volume of water was two (2) *Oreochromis niloticus* per 1 litre of water, stocked in the four different containers (Jerican, Plastic bucket, Plastic trough and Polythene bag) and in triplicates.

Data Analysis

The data obtained from the experiment was subjected to one-way analysis of variance (ANOVA), to compare the change in temperature, pH, DO and ammonia before and after transportation. Significance between mean values were determined using the SPSS (Statistical Package for Social Sciences) and least significant difference (LSD) as described by Steel and Torie (1987).

Results

The water quality parameters in the different transporting containers are reported in Table 1. The result showed that Ammonia was the same for plastic trough and polythene bag (0.031±0.00064) and differed slightly for plastic bucket (0.025±0.00151) and open Jerican (0.0303± 0.00039). There was no significant difference ($p>0.05$) in the Ammonia content among the containers.

There was significant difference at the end of the transportation with reference to temperature change. The temperature of water in open Jerican (29.22±1.07755) was highest, followed by polythene bag (28.66± 1.03772), Plastic bucket (26.89±0.79528) and Plastic trough (21.33±0.13070) was the least after transportation compared to the control (21.6^{0}C)
The dissolved Oxygen content after transportation was highest in Plastic trough (7.7±0.20051), closely followed by open Jerican (7.53±0.16614), Plastic bucket (6.42± 0.22485), and least was in Polythene bag (5.75±0.32991). There was significant difference ($p<0.05$) in the dissolved Oxygen after fish transportation.

The result also showed that the hydrogen ion concentration for Plastic bucket (6.2± 0.15287), open Jerican (6.3±0.08264), Plastic trough (6.5±0.08136) and Polythene bag (6.43±0.09614) varied after transportation. There was significant difference ($p<0.05$) in the hydrogen ion concentration after fish transportation.

The result in Table 2 showed the relationship of the transporting containers in response to the survival of *Oreochromis niloticus* fingerlings. Plastic bucket and open Jerican did better (95%), having less mortality while Plastic trough and Polythene bag had the least survival, having more mortality (93%). There was significant difference ($p<0.05$) in the percentage survival after fish transportation.

Table1: Mean water quality parameters in the different transporting containers of *Oreochromis niloticus*

Containers	Ammonia	Temperature^{0}C	Dissolved Oxygen(mg/l)	pH
Control	0.03	21.6	6.87	6.8
PLB	0.025 ± 0.00151^{ab}	26.89 ± 0.79528^{c}	6.42 ± 0.22485^{c}	6.2 ± 0.15287^{cd}
OPJ	0.03 ± 0.00039^{a}	29.22 ± 1.07755^{a}	7.53 ± 0.16614^{b}	6.3 ± 0.08264^{c}
PLT	0.031 ± 0.00064^{a}	21.33 ± 0.13070^{d}	7.7 ± 0.20051^{a}	6.5 ± 0.08136^{a}
POB	0.031 ± 0.00064^{a}	28.66 ± 1.03772^{b}	5.75 ± 0.32991^{d}	6.43 ± 0.09614^{b}

Means with different superscripts are significantly different ($P < 0.05$)
Keys:
Control: Water quality parameters at the point of collection
PLB: Plastic Bucket
OPJ: Open Plastic Jerican
PLT: Plastic Trough
POB: Polythene Bag

Table 2: Percentage survival of *Oreochromis niloticus* fingerlings exposed to different transporting containers

S/No.	Plastic bucket	Open Jeri can	Plastic trough	Polythene bag
1	95c	100a	100a	95a
2	90c	100a	80b	90b
3	100a	85b	100a	95a
Mean % Survival	95	95	93	93

Means with different superscripts are significantly different ($P < 0.05$)

Discussion

Physiochemical analysis showed that the mean temperature for plastic bag, open jerri can, plastic trough and polythene bag were 25.29±0.79528, 27.3350±1.07755, 21.4175±0.13070 and 26.9175±1.03772 respectively. This shows that there was minimum temperature variation across the transporting containers for fish survival and growth. This temperature range is within the ideal temperature of 25^0C-32^0C (Adekoya *et al*, 2004). Other external factors like climate must have influenced the changes observed. This is in accordance with the works of Timms (2001), which noted that climatic factors were the determining factor for increase or decrease in temperature.

The average dissolved Oxygen for Plastic bucket, Open Jerican, Plastic trough and Polythene bag were 6.42±0.22485, 7.53±0.16614, 7.76±0.20051 and 5.75±0.32991 respectively. Dissolved oxygen was highest for plastic trough (7.7mg/l), probably due to large surface area when compared to the other transporting containers.

Dissolved oxygen for optimal fish growth must not be less than 4mg/l (Adekoya *et al*., 2004). The dissolved Oxygen increased for open Jerican (7.3675mg/l) and plastic trough (7.5350mg/l) but decreased in closed containers. This is in agreement with the results of Crosby *et al*., (2006) who reported that as the duration of transportation increases, the dissolved Oxygen content of the water decreases and that dissolved oxygen concentration in the transport containers changes greatly during the transport of fish.

The average hydrogen ion concentration for Plastic bag, Open Jerican, Plastic trough and Polythene bag were 6.2550±0.15287, 6.7225±0.08264, 6.6175±0.08136 and 6.3250±0.09614 respectively. This showed that there was minimum variation in pH across the transporting containers. The pH decreased moderately from the commencement of transportation till the end of transportation. This is in accordance to Crosby *et al*., (2006) that reported a decrease in pH of water during transportation of fish.

The mean ammonia for Plastic bag, Open Jerican, Plastic trough and Polythene bag were slightly different at the commencement of transportation and after transportation. This is in accordance to the work of Smutna *et al*. (2002) which stated that exhaustive exercise increased active energy demand in fish resulting to an increase in ammonia level. Dobsikova *et al*. (2009) stated that the elevated ammonia in the transport water may be attributed to the higher fish metabolic rate.

The survival rate of fish in all the transporting containers were very high indicating that the use of Plastic bag, Open Jerican, Plastic trough and Polythene bag for transporting *Oreochromis niloticus* fingerlings do not have negative effects on the fish survival. However, plastic bucket and Open Jerican performed better than Plastic trough and Polythene bag.

Conclusion

This study has shown that the use of plastic bag, polythene bag, Open Jerican and Plastic trough for transporting *Oreochromis niloticus* fingerlings at a stocking density of 2 fish/litre showed a positive trend in water quality parameters and fish survival. Plastic bucket and Open Jerican performed better than Plastic trough and Polythene bag. Fish hatcheries Managers are encouraged to exploit the result of this research to enhance the transportation of *Oreochromis niloticus* to their customers.

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