Effect of different cooking oils on the activity and survival of juvenile *Clarias gariepinus* during transportation

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Abstract
One of the very affordable means of fish transportation is the use of jerricans with trace quantity of cooking oils added to the transporting medium. These oils are added to ensure survival of fish en-transit. This work seeks to test the effect of different cooking oils on the activity and survival during transportation of juvenile *Clarias gariepinus*. The experiment was set up as a Completely Randomized Design (CRD) made up of four treatments of oil additions namely; T_1 (control; transportation water without oil), T_2 (transportation water with palm oil), T_3 (transportation water with groundnut oil), T_4 (transportation water with sunflower oil), T_5 (transportation water with ripe palm fruit). Each treatment was replicated three times. Some water quality parameters were measured while survival and mobility of the fish as well as the cost per litre of the oils were also evaluated. The result shows significant differences ($p<0.05$) in DO with T_5 (0.700mg/l) having the least dissolved oxygen while T_1 (2.967mg/l) had the highest dissolved oxygen. T_1 (6.484) had the least pH while T_5 (6.833) had the highest pH. T_3 (4.857) had the least Total Ammonia Nitrogen while T_5 (4.857ppm) had the highest Total Ammonia Nitrogen (8ppm). T_5 (1.5) had the least mobility indicating moderately active while T_1(1.25) had the highest mobility indicating high activity. There was no significant differences ($p<0.05$) in fish mortality. Soya bean oil (₦2800) was the most expensive and significantly different($p<0.05$) from the other Treatments. It was concluded that transporting medium containing palm oil holds the best potential based on cost per litre, dissolved oxygen, temperature, pH, survival rate, mobility and Total Ammonia Nitrogen.
Keyword: *Clarias gariepinus, cooking oils, mobility, survival and transportation*

Introduction

The concept of fish transportation within aquaculture systems encompasses emphasis on the critical importance of optimal conditions, and enhanced welfare and productivity of farmed fish populations, when fish is moved from one location to another (Oscar *et al.,* 2024). Transporting live fish is a difficult task in fish farming, because the limited water exchange results in low dissolved oxygen levels, which can be harmful to fish (Adeyemo *et al.,* 2009). Fry and fingerlings are usually transferred from the hatchery to the pond for stocking (Author, 2006). When fish arrive at the market or pond in poor physiological state due to transporting stress, it results to high mortality at the time of stocking or shortly after (Mohamed *et al.,* 1997). Transportation of fish must be carefully done in order to be successful. A poorly organized effort may result in fish mortality (Author, 2006). Fish transportation is an essential part of aquaculture. It involves movement of small or large quantity of fish over a certain distance to the waters where they are supposed to be stocked (Orji, 2005; Akinrotimi *et al.,* 2007). The are reasons for fish transportion, include; collection and transportation of broodstock, fingerlings, juveniles and adult fish to stocking sites, market and furthermore, with the aim of introducing fish species into a new environment (Cooke *et al.,* 2004; Akinrotimi *et al.,* 2013).

Several authors have deduced that during the transportation of fish from one location to another, the activity could cause stress, which can negatively affect the performance of fish and along the line reduce its survival in culture conditions (Akinrotimi *et al.,* 2011; Kiessling *et al.,* 2009). Intense stressors such as handling and transportation can indeed lead to significant losses and high mortality rates in recently stocked fish farms (Akar, 2011). Fish seed, such as fingerlings and juveniles, are typically moved from the nursery to the designated culture site. Throughout this procedure, it is essential that the fish reach the farm in a healthy physiological state. A stable water quality is maintained in transit. Various factors determine the required water quality parameters. For example, the oxygen requirement for fish is determined by three basic factors namely; fish species, size of fish and water temperature (Ganga *et al.,* 2014). The response of various fish species to low levels of dissolved oxygen varies, depending on factors like their species, life processes (feeding, growth, reproduction), and life stages (eggs, larvae, adults) as reported by Ganga *et al.* (2014). Cold-water fish generally need higher oxygen concentrations compared to warm-water species. Fish like catfish, which are accustomed to slow moving water environments, can endure lower oxygen levels compared to those adapted to fast-moving water conditions. Even within a specific species, younger fish typically necessitate higher oxygen levels than their adult counterparts (FAO, 2007).

In Nigeria, *Clarias gariepinus* is mostly farmed due to its fast growth rate and ability to tolerate a wide range of temperature and low dissolved oxygen among other qualities. Because of its high value as food, many commercial fish farms, government fisheries stations and institutions produce this species extensively and intensively. The fish seeds must get to destinations for grow outs which may be far away from the fish hatcheries. Hence, the transportation of fish seed is almost unavoidable. The way and manner fish seeds are transported is a very important aspect of fish culture. Finding the most effective way to transport fish seed means a reduction in loss of fish and money.

In Nigeria today, the different methods used in transporting fish is the open and closed system of transportation. The more common method is the open system of transportation which involves the use of earthen pots, barrels, plastic (FAO 2007) or metal buckets and kegs (jerry cans). The less common method is the closed system which involves the use of oxygen bags.

A common practice adopted by fish farmers in Nigeria today in transporting fish seed is the use of ripe palm fruits, palm oil, etc added to water in the medium for transporting the fish in varying quantities to reduce their stress level and mortality in transit (verbal communication with some fish farmers at Uteh fish farming cluster in Benin City, Edo State, Nigeria). However, there is little or insufficient data on the efficiency of using readily available cooking oil in the transportation of fish seeds even though it is already practiced in some areas in Nigeria. Falaye *et al.* (2012) investigated the effect of palm oil on the physical appearance of *Clarias gariepinus* during transportation. He did not consider the use of other oils nor its effect on the survival of fish seeds. Thus, this study sought to evaluate the sustainability and effectiveness of using different types of cooking oil to reduce the stress level and mortality in transit of juvenile *Clarias gariepinus*.

Materials and methods

Experimental site

This study was conducted at the Department of Aquaculture and Fisheries Management, Faculty of Agriculture, University of Benin, Benin City Edo State. The location is in the tropical rainforest zone. Its characteristics uniform temperature, well distributed rainfall which ranges between 150mm-250mm, luxuriant vegetation amongst others.

Experimental design

The study was set up as a Completely Randomized Design (CRD) with four treatments (T) and three replications (R). The treatments used include:

T_1: Control (no cooking oil was added)

T_2: Palm oil (2ml/L) was added to transportation water

T_3: Groundnut oil (2ml/L) was added to transportation water

T_4: Soya bean oil (2ml/L) was added to transportation water

T_5: 5 Ripe palm fruits were added to transportation water

Experimental fish

The fish used for this experiment was obtained from a reputable fish farm in Benin City, Edo State. The total number of juvenile *Clarias gariepinus* used was 450. Each treatment had three replications containing apparently healthy thirty juvenile *Clarias gariepinus.* After the fish was acquired, they were brought to the experimental site to be acclimatized under laboratory conditions.

Experimental procedure

A total of 15 jerricans were used for this study. A 10 liter jerrican was used and filled with 5 liters of water using a graduated beaker. The quantity that was added of the different cooking oils was 5 ml (equal to 1teaspoon) per replication in each treatment. The treatment for ripe palm fruits had five pieces each in the replications. After the treatment was set up, it was stirred with a glass rod for a homogenous mixture. The fish was later introduced into the experimental plastic rubber used for transportation and stored at ambient temperature. This was at the rate of 30 fishes per tank (5L water) in each triplicate treatment.

Data collection

The data was collected at interval of 0 hours, 3 hours, 6 hours and 12 hours. The initial amount of each parameter and subsequent amount of each parameter was measured. The value for each hour and the mean of each parameter was evaluated. The fish were observed to be able to estimate the mobility and agility of the fish. The total number showing signs of weakness was noted and recorded.

During the study, dissolved oxygen meter was used to monitor the dissolve oxygen level at the stipulated intervals. The brand name of the dissolved oxygen meter used was dissolved oxygen analyzer.

The pH during this study was measured at intervals using hand held pH meter. Api ammonia test kit was used to monitor the total ammonia nitrogen. The temperature was measured using a D.O analyzer. Motility of fish was monitored using a scale; very active, active, moderately active and inactive (Kim *et al.,* 2018). The total number of fish remaining in each replicate was collected per treatment and the average value was recorded. This was used to calculate the percentage survival at the end of the study as follows;

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$$\text{Survival of fish } (\%) = \frac{\text{Number of fish after termination of study}}{\text{Number of fish before loading fish in the jericans}} \times 100$$

Cost of the different cooking oils used (per litre) was recorded.

Data analysis

Data obtained was subjected to Analysis of Variance (ANOVA) using Genstat statistics package. The differences between the means were separated using Duncan Multiple Range Test (DMRT) at 5% probability.

Results and Discussion

The results of this study are presented and discussed below;

Discussion

Survival

Survival was very high in all treatments and was not significantly different (p<0.05) among treatments. This is similar to the findings of Falaye *et al*. (2012), while studying the effects of palm oil on the physical appearance of *Clarias gariepinus* during transportation.

Fish Mobility

There was significant difference (p<0.05) in the mobility of the fish among treatments. Treatments T3 and T4 (1.750 each) and Treatment T2 and T5 (1.500) were not significantly different from each other at 5% probability. T1 (1.250) the control, had the least mobile fish and was significantly different (p<0.05) from the rest. This suggests that the addition of oils of all forms aided in improving the mobility of the fish which culminated in the observed high survival in the study. Oils, including clove oil has been proven to have such quality even in Tilapia according to Akar (2011) while looking on the effects of clove oil on the response of blue tilapia (*Orechromis aureus)* to transportation stress.

Cost of oil per transporting unit

The cost of the oils per liter were significantly different (p<0.05) among treatments. Soya bean oil (₦2,800) was the most expensive followed by ground nut oil (₦ 2300) then palm oil (₦ 1500) and the palm fruits the least (₦ 100). This difference in cost can be attributed to the value additions as the least processed palm fruits cost the least per 2.5 seeds i.e. equivalent of halve of the total needed per replicate.

Water quality parameters.

The water quality parameters monitored in this study and discussed below are in compliance with those treated as critical during transportation as recommended by Oscar *et al*., (2023). All parameters worsened over time as shown in Table 2.

Dissolve oxygen: Table 1 shows that there was significant different between all treatments (p<0.05), except for T3 (1.775mg/l) which were not significantly different from each other (p>0.05). The transport water containing no oil (T1) had the highest dissolved oxygen while the transporting water containing ripe palm fruit (T5) had the least dissolved oxygen. This may be attributed to the increased competition for space by the fish in this treatment as the fish were observed to have struggled more in this transport medium. The increased demand for dissolved oxygen may have been as a result of increased temperature from competition for space thus increasing fish weight per unit area and the attendant increased quantity of waste produced (Berka, 1986).

Temperature

As shown in Table 1, the temperature across all treatments were not significantly different from each other (p>0.05) across T1(29.22ºC) to T4(29.14ºC). T5 (29.9ºC) was shown to be significantly different (p<0.05) from other treatment having the highest temperature. This may have resulted in the least amount of dissolved oxygen recorded in this treatment. An increase in temperature by 5℃ results in increased metabolism and therefore increased dissolved oxygen demand resulting in a buildup of ammonia and carbon (IV) oxide and a decrease of the 5℃ implies low metabolism, reduced dissolved oxygen and thus ammonia and carbon (IV) oxide build up (Kim *et al*., 2018).

pH

As shown in Table 1, the pH across all treatment was significantly different from each other. T1(6.484) is slightly significantly different from T2(6.558), as T4(6.548) is slightly significantly from T2(6.558). T2(6.558), T3(6.631) and T5(6.833) are significantly different from each other (p<0.05). T5(6.833) having the highest and T1(6.484) having the least pH. None of the pH values where extremely out of range to be of concern in the study. The result obtained was in accordance with the work of Oscar *et al.*, (2023) who recommended a pH range of 6.5-9.5.

Total Ammonia Nitrogen (TAN)

As shown in Table 1, the Total Ammonia Nitrogen in T1 (4.857ppm) and T2 (4.917ppm) were not significantly different from each other (p>0.05). T3 (4.583ppm) to T5 (8ppm) were significantly different from another (p<0.05). T5 (8ppm) had the highest and T3 (4.583ppm) with the least Total Ammonia and Nitrogen. The highest values of TAN in T5 could be due to the reduced dissolve oxygen emanating from competition for space and the attendant increase in feacal deposit. While these activity increases the temperature in the medium putrefaction is also increased releasing amino groups into the medium of transportation. T3 had the least TAN suggesting that the medium was most soothing for the fish. Similar conclusions where made by Sasikumar *et al*, (2015) when they used groundnut oil and benzocaine as tranquilizer for *O. niloticus* during handling.

Mobility

As shown in Table 1, it mobility was indicative across all treatments. T1 (1.250) indicating very active is significantly different from all the other treatment (p0.05). T2 (1.5) and T5 (1.5) indicating moderately active are not significantly different from one another (p0.05). T3 (1.75) and T4(1.75) indicating active are not significantly different from one another (p<0.05). The fish in all the Treatments did not show inactivity suggesting lack of weakness from stress.

Survival Rate

As shown in Table 1, the survival rate from T1 (99%) to T5(100%) are not significantly different across all treatment (p<0.05). The oils may have aided survival. This is similar to the findings of Falaye *et al*. (2012), when they worked on Effects of Palm oil on the physical appearance of *Clarias gariepinus* during Transportation where they concluded that there was 99-100% survival rate of *Clarias gariepinus* after the study. Palm oil has, oleic acid (C18:1) which aids the survival of fish during transportation as observed by Ramos (2018).

Conclusion

At the end of this experiment, it was discovered that the transporting medium containing oils have holds potentials for use in transportation of the study fish. The addition of oils of all forms from different sources aided in maintaining the mobility of the fish which was superior to the control in this study. Palm oil (T2) holds the best potential, especially from the cost implication. The use of ripe palm fruit was the least recommended based on this findings.

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Table 1: Water quality parameters mobility and fish survival, and cost of oils during the study

Treatment / **Water Parameter**	**T1**	**T2**	**T3**	**T4**	**T5**
Dissolved Oxygen	2.967^{d}	2.300^{c}	1.775^{b}	1.742^{b}	0.700^{a}
Temperature	29.22^{a}	29.35^{a}	29.22^{a}	29.14^{a}	29.90^{b}
pH	6.484^{a}	6.558^{b}	6.631^{c}	6.548^{ab}	6.833^{d}
Total Ammonia and Nitrogen	4.857^{ab}	4.917^{ab}	4.583^{a}	5.333^{b}	8.000^{c}
Mobility	1.250^{a}	1.500^{b}	1.750^{c}	1.750^{c}	1.500^{b}
Survival	99.920^{a}	100.000^{a}	99.830^{a}	99.920^{a}	100.000^{a}
Cost of oils(₦ per litre)	No oil	1500^{c}	2300^{b}	2800^{a}	100^{d}

Means with same superscripts across rows are not significantly different at 5% probability

Table 2: Mean water quality parameters, mobility and fish survival across time during the period of study

Time / Water parameter	0^{th} hour	3^{rd} hour	6^{th} hour	12^{th} hour
Dissolved Oxygen	2.707^{c}	2.053^{b}	1.453^{a}	1.373^{a}
Temperature	27.29^{a}	29.30^{b}	30.93^{c}	29.95^{d}
pH	6.155^{a}	6.586^{b}	6.773^{c}	6.929^{d}
Total Ammonia and Nitrogen	2.152^{a}	4.533^{b}	7.467^{c}	8.000^{d}
Mobility	1.000^{a}	1.533^{b}	1.067^{a}	2.600^{c}
Survival Rate	100.000^{b}	100.000^{b}	100.000^{b}	99.000^{a}

Mean with same superscripts across rows are not significantly different at 5% probability