



Growth Responses of Nile Tilapia (*Oreochromis niloticus*) Exposed to Different Concentrations of Detergents Powder

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Authors' contributions

This work was carried out in collaboration between all authors. Author JAP designed the study, performed the statistical analysis, wrote the protocol and first draft of the manuscript. Authors ARO and ALA managed the analyses of the study. Author ARO managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

The study on the growth responses of *Oreochromis niloticus* exposed to different concentrations of detergents powder was carried-out using a 30 day renewal bioassay in triplicates. A total of 360 *Oreochromis niloticus* fingerlings, with a mean body weight of 18.2 ± 3.02 g were used for the study. Ten fingerlings were stocked in each aquarium containing 10 litres of water and exposed to 0, 1.5 and 9 ml concentrations of detergents. The DWG, PWG, SGR and SR (growth responses) of the test fish varied significantly between the fish groups exposed to different concentrations of detergent "A", "B" and "C" at $p < 0.05$, having homogenous variances in each group ($p > 0.05$). The DWG, SGR, SR and PWG of the test fish decreased with increase in the concentration of each detergent, with the highest growth reduction of 0.50 ± 0.05 g (DWG), $1.34 \pm 0.11\%$ (SGR), $46.67 \pm 11.55\%$ (SR) and $33.14 \pm 2.21\%$ (PWG) for detergent "A"; 0.41 ± 0.06 g (DWG), $0.50 \pm 0.06\%$ (SGR), $36.67 \pm 5.77\%$ (SR) and $28.96 \pm 2.77\%$ (PWG) for detergent "B"; 0.39 ± 0.01 g (DWG), $0.47 \pm 0.02\%$ (SGR), $30.00 \pm 10.00\%$ (SR) and $27.85 \pm 0.77\%$ (PWG) for detergent "C" observed at the

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highest concentration, compared to 0.81 ± 0.10 g (DWG), $1.98 \pm 0.19\%$ (SGR), $90.00 \pm 10.00\%$ (SR) and $44.73 \pm 3.10\%$ (PWG) for the control group. When the fingerlings were exposed to the detergents, behavioural changes like; erratic swimming, loss of equilibrium, poor feeding, change in colour and respiratory disturbances were observed. The fish growth had a decreasing sequence of detergent A > B > C, as a result, the fish group exposed to detergent "A" had the best growth performance aside from the control group, while detergent "C" group had the worse growth. This indicates that detergent "A" is the least toxic, while detergent "C" is the most toxic. This findings indicated that detergents affected the growth of the test fish. As a result of the effect of detergents on the growth of fish, it is necessary that adequate management strategies like; continuous monitoring of aquatic eco-system and placing ban on indiscriminate discharge of detergent effluents into waterways are put in place. It is also recommended that more studies on the haematological, histological and enzymes alterations of *Oreochromis niloticus* exposed to different concentrations of detergents are carried-out, so as to further reveal the adverse effect of detergents on aquatic organisms.

Keywords: Growth responses; concentrations; detergents; *Oreochromis niloticus*.

1. INTRODUCTION

Detergents, including the bio-degradable ones, have been discovered to induce poisonous effects and osmo-regulatory imbalance in aquatic lives especially if present in concentrations that exceed metabolic demand [1]. Such xenobiotic compounds could be persistent and more mobile in soil and water; hence they are known to be among the most common terrestrial and aquatic contaminants [2]. Detergent effluents and discharges have also been noticed to induce severe damage to such vital organs like; gills, liver, kidney, skin, heart and brains [3]. Surfactants are the components mainly responsible for the cleaning action of detergents. In commercial detergents, the surfactant component is between 10 and 20%. The other components include; bleach, filler, foam stabilizer, perfume, soil-suspending agents, enzymes, dyes, optical brighteners and other materials designed to enhance the cleaning action of the surfactant [4]. Detergent surfactants are complex organic chemicals where hydrophilic and hydrophobic groups are joined together in the same molecules [5]. The most widely used surfactant for detergents formulations is the linear alkyl benzene sulfonate (LAS). It was introduced as biodegradable alternatives to the non-biodegradable branched-chain alkylbenzene sulfonates. However, they induce stress conditions, which impair fish health [1].

Studies have revealed that indiscriminate deposition of effluents/toxicants into an aquatic eco-system might decrease the dissolved oxygen concentration, which stand to impair respiration, leading to asphyxiation (which is an indication of unconsciousness or death produced by failure of

blood to become properly oxygenated in lungs) and may ultimately result into organ architectural degradation such as; liver dysfunction [6]. Contamination of aquatic phase by detergents has been reported in aquatic organisms such as fish [7].

Fishes are widely used to evaluate the health of aquatic eco-system and their physiological changes serve as biomarkers of environmental pollution [8]. [9], reported that detergents reduce the growth rate of African catfish. Most fish dies when detergent concentrations approach 15 parts per million [10]. *Oreochromis niloticus* commonly known as Nile tilapia is a freshwater fish distributed in the tropical zones around the world. It is an important culture fish because it reproduces very easily and does not have feeding problem [11]. The study was aimed at assessing the growth reduction of *Oreochromis niloticus* exposed to different concentrations of Ariel and Omo detergents.

2. MATERIALS AND METHODS

2.1 Study Area

The research was carried-out in the Department of Zoology and Environmental Biology Laboratory, University of Calabar, Calabar, Cross River State.

2.2 Collection of Test Fish

A total of three hundred and sixty (360) healthy fingerlings of *Oreochromis niloticus*, were used through-out the study. Fish samples were collected from the hatchery unit of University of Calabar fish farm and transported to Zoology and

Environmental Biological Laboratory using an aerated twenty litres (20 litres) of open plastic rubber, partially filled with habitat water for acclimation and research proper.

2.3 Collection of Test Toxicants

The Ariel (detergent "A") and Omo (detergent "B") detergents used for this study were purchased from Watt Market, Calabar. The detergents were in powder form, soluble in water and contain linear Alkyl benzene sulfonate surfactants (LAS) as its major active component.

2.4 Acclimation of Test Fish

In the laboratory, the fishes were allowed to acclimate to the Laboratory conditions for two weeks (i.e 14 days), during which they were fed twice daily with copen at 5% of their body weight [12,13]. The culture water was changed every two days to remove faecal and unconsumed feeds using siphoning method, during which water was constantly aerated using air pump, so as to maintain optimal level of dissolved oxygen. The water quality was constantly monitored during this period. The temperature, pH and dissolved oxygen were monitored through-out. The temperature was measured using mercury-in-glass thermometer to the nearest degree Celsius (°C), while the pH was measured using a Ph-FixO-14 Macherey-Nagel model pH meter and the dissolved oxygen was measured using a DO analyser JDB 607 model dissolved oxygen meter to the nearest milligram per liter (mg/l).

2.5 Preparation of Stock Solution

Fifty grams (50 g) of each detergent was mixed with five litres (5 l) of water, to get a stock solution required for the study, through which the mixture was diluted into 1, 5 and 9m/l (millilitres) of the Ariel (detergent "A"), Omo (detergent "B") and combined (i.e Ariel + Omo) (detergent "C").

2.6 Experimental Procedure

A total of three hundred and sixty (360) fingerlings of *Oreochromis niloticus* were used through-out the study, with ten (10) fingerlings stocked per group. The fish were exposed to 0, 1, 5 and 9 ml concentrations of the different detergents in a 25 x 15.5 x 15.5 cm³ aquarium containing ten litres (10 l) of de-chlorinated tap

water. One hundred and twenty (120) fingerlings were exposed to each detergent; giving a total of three hundred and sixty (360) fingerlings. There was a control group, which was not exposed to any detergents, which formed the basis for comparison of growth responses of the test fish. Each fish group was exposed to 0, 1, 5 and 9 ml concentration of the different detergents in triplicates. The experiment was a renewable test, where the culture water was renewed every 72 hours, and fed daily 5% of their body weight to enhance fast growth of the test fish. The experiment lasted for a duration of thirty days (30 days), during which the weight of the fish fingerlings was taken immediately after acclimation in grams prior to their exposure and after thirty days of exposure to the detergents (30th day). The weights of the fishes were taken using Meltlar-2000D model electronic sensitive weighing balance and dead fingerlings were siphoned out from the aquarium, to ensure that a healthy culture water is maintained through-out the study.

2.7 Growth Response Indices

Daily weight rate: (DWG) (g) of *Oreochromis niloticus* exposed to different concentrations of the different detergents was calculated according to [5] using the formula:

$$DWG (g) = \frac{W_t - W_0}{W_0 (t)} = \frac{\text{Final Weight} - \text{Initial Weight}}{\text{Initial Weight} \times 30 \text{ days}}$$

Specific growth rate: (SGR) (%) of *Oreochromis niloticus* exposed to different concentrations of the different detergents was calculated according to [9] using the formula:

$$SGR (\%) = \frac{\log_e W_2 - \log_e W_1}{\text{Number of days}} \times 100$$

Where W_2 = Weight of fish at time T_2 (Final)
 W_1 = Weight of fish at time T_1 (Initial)
 \log_e = logarithm of a natural number to base of a constant e
 $E = 2.718281828459$

Survival rate (SR): (%) of *Oreochromis niloticus* exposed to different concentrations of the different detergents was calculated according to [9] using the formula:

$$SR (\%) = \frac{N_2}{N_1} \times 100$$

Where N_2 = Total fish number harvested
 N_1 = Total fish number stocked

Percentage weight gain (PWG): (%) of *Oreochromis niloticus* exposed to different concentrations of the different detergents was calculated according to [5] using the formula:

$$PWG = x = \frac{W_2 - W_1}{W_1} \times 100$$

Where W2 = Final weight
W1 = Initial weight

2.8 Statistical Analysis

All obtained growth response data were subjected to descriptive statistics (Mean and standard deviation). Analysis of variance (ANOVA) was used to test for the significance of the difference in the growth responses of fish samples between the different concentrations (0, 1, 5 and 9 ml) of Ariel, Omo and combined (Ariel + Omo) at 0.05 level of significance and at their relevant degree of freedom. All analysis were carried-out using predictive analytical software, version 20. The growth responses graphs were plotted using Microsoft excel, version 2013.

3. RESULTS

3.1 Behavioural Changes and Mean Body Weight of Fish

The mean body weight of the three hundred and sixty (360) *Oreochromis niloticus* fingerlings used through-out the study was 18.2 ± 3.02 g. When the fingerlings were exposed to the different detergents, behavioural changes like; erratic swimming, loss of equilibrium, poor feeding, change in colour and respiratory disturbances were observed.

3.2 Growth Response in Fish Exposed to Ariel Detergent (Detergent “A”)

The summary of the growth responses of *Oreochromis niloticus* fingerlings exposed to different concentrations of Ariel detergent for 30 days is shown in Table 1. The respective growth response parameters of fish exposed to 0, 1, 5 and 9ml concentration of Ariel for 30 days were: 15.57 ± 1.91 g, 16.31 ± 1.28 g, 18.96 ± 1.42 g and 18.80 ± 1.03 g respectively for mean initial weight; 28.07 ± 1.91 g, 28.37 ± 1.33 g, 30.07 ± 2.09 g and 28.11 ± 1.08 g respectively for final weight; 0.81 ± 0.10 g, 0.74 ± 0.06 g, 0.59 ± 0.03 g and 0.50 ± 0.05 g respectively for daily weight gain; 1.98 ± 0.19%, 1.85 ± 0.11%, 1.54 ± 0.06% and 1.34 ± 0.11% respectively for specific growth rate; 90.00 ± 10.00%, 76.67 ± 11.55%, 56.67 ± 15.28% and 46.67 ± 11.55% respectively for survival rate; 44.73 ± 3.10%, 42.59 ± 1.92%, 36.95 ± 1.07% and 33.14 ± 2.21% respectively for percentage weight gain.

The daily weight gain, specific growth rate, survival rate and percentage weight gain of fish decreased with increase in the concentration of the Ariel detergent after 30 days exposure. The daily weight gain, specific growth rate, survival rate and percentage weight gain varied significantly between the fish groups exposed to different concentrations of ariel at p<0.05, having homogenous variances in each fish group (p>0.05).

3.3 Growth Response in Fish Exposed to OMO Detergent (Detergent “B”)

The summary of the growth responses of *Oreochromis niloticus* fingerlings exposed to different concentrations of Omo detergent for 30

Table 1. Growth response of *Oreochromis niloticus* exposed to different concentrations of Ariel detergent

Growth parameters	Ariel detergent (detergent “A”)			
	0 m/l	1 m/l	5 m/l	9 m/l
Initial weight (g)	15.57 ± 1.91 ^a	16.31 ± 1.28 ^b	18.96±1.42 ^c	18.80 ± 1.03 ^d
Final weight (g)	28.07 ± 1.91 ^a	28.37 ± 1.33 ^b	30.07±2.09 ^c	28.11 ± 1.08 ^d
Daily weight gain (g)	0.81 ± 0.10 ^a	0.74 ± 0.06 ^b	0.59 ±0.03 ^c	0.50 ± 0.05 ^d
Specific growth rate (SGR) (%)	1.98 ± 0.19 ^a	1.85 ± 0.11 ^b	1.54 ±0.06 ^c	1.34 ± 0.11 ^d
Survival rate (SR) (%)	90.00 ± 10.00 ^a	76.67±11.55 ^b	56.67±15.28 ^c	46.67 ± 11.55 ^d
Percentage weight gain (PWG) (%)	44.73 ± 3.10 ^a	42.59 ± 1.92 ^b	36.95 ± 1.07 ^c	33.14 ± 2.21 ^d

Growth parameters are in mean ± standard deviation
Values with different superscript are significantly different at p<0.05

days is shown in Table 2. The respective growth response parameters of fish exposed to 0, 1, 5 and 9ml concentration of Omo for 30 days were: 15.57 ± 1.91 g, 16.67 ± 1.14 g, 16.13 ± 1.45 g and 18.18 ± 1.44 g respectively for mean initial weight; 28.07 ± 1.91 g, 28.18 ± 1.81 g, 24.02 ± 1.49 g and 25.48 ± 1.58 g respectively for final weight; 0.81 ± 0.10 g, 0.69 ± 0.03 g, 0.49 ± 0.06 g and 0.41 ± 0.06 g respectively for daily weight gain; 1.98 ± 0.08%, 0.76 ± 0.03%, 0.58 ± 0.06% and 0.50 ± 0.06% respectively for specific growth rate; 90.00 ± 10.00%, 56.67 ± 5.77%, 46.67 ± 5.77% and 36.67 ± 5.77% respectively for survival rate; 44.73 ± 3.10%, 40.86 ± 1.13%, 32.94 ± 2.60% and 28.96 ± 2.77% respectively for percentage weight gain.

The daily weight gain, specific growth rate, survival rate and percentage weight gain of fish decreased with increase in the concentration of the omo detergent after 30 days exposure. The daily weight gain, specific growth rate, survival rate and percentage weight gain varied significantly between each fish exposed to different concentrations of omo at p<0.05, and having homogenous variance in each fish group (p>0.05).

3.4 Growth Response in Fish Exposed to Combined Detergent (Ariel and OMO) (Detergent "C")

The summary of the growth responses of *Oreochromis niloticus* fingerlings exposed to different concentrations of Ariel and Omo combination for 30 days is shown in Table 3. The respective growth responses of fish exposed to 0, 1, 5 and 9 ml concentration of Ariel and Omo combination for 30 days were: 15.57 ± 1.91 g, 16.15 ± 1.12 g, 16.90 ± 0.50 g and 18.67 ± 0.52 g respectively for mean initial weight; 28.07 ± 1.91 g, 26.35 ± 1.12 g, 25.03 ± 0.81 g and 25.87 ± 0.46 g respectively for final weight; 0.81 ± 0.10 g, 0.63 ± 0.04 g, 0.48 ± 0.07 g and 0.39 ± 0.01 g respectively for daily weight gain; 1.98 ± 0.08%, 0.71 ± 0.04%, 0.57 ± 0.07% and 0.47 ± 0.02% respectively for specific growth rate; 90.00 ± 10.00%, 50.00 ± 10.00%, 36.67 ± 5.77% and 30.00 ± 10.00% respectively for survival rate; 44.73 ± 3.10%, 38.77 ± 1.65%, 32.40 ± 3.36% and 27.85 ± 0.77% respectively for percentage weight gain.

The daily weight gain, specific growth rate, survival rate and percentage weight gain of fish decreased with increase in concentration of the combined detergent after 30 days. The daily

weight gain, specific growth rate, survival rate and percentage weight gain varied significantly between each fish group exposed to different concentrations of combined detergent at p<0.05, and having homogenous variances in each group (p>0.05).

3.5 Comparison of the Growth Responses in Fish Exposed To Ariel, OMO And Combined Detergent

The variations in the daily weight gain (DWG), specific growth rate (SGR), survival rate (SR) and percentage weight gain (PWG) of *Oreochromis niloticus* exposed to different concentrations (0, 1, 5 and 9 ml) of Ariel, Omo and combined detergents are showed in Figure 1 – 4. The figures revealed that daily weight gain (DWG), specific growth rate (SGR), survival rate (SR) and percentage weight gain (PWG) of *Oreochromis niloticus* for each of the 0, 1, 5 and 9 ml concentrations compared for each detergent was highest in Ariel, and lowest in the combined detergent; in the growth sequence of Ariel > Omo > combined. This indicated that Ariel was the least toxic detergent, followed by Omo, with the combined detergent being the most toxic. This also revealed that the best fish growth aside the control group was observed in the group exposed to Ariel, but worst growth responses were observed for the combined detergent group.

4. DISCUSSION

Detergents, including the bio-degradable ones have been discovered to induce poisonous effects and osmo-regulatory imbalance in aquatic lives especially if present in concentration that exceed metabolic demand [1]. Fishes are widely used to evaluate the health of aquatic eco-system and their physiological changes serves as biomarkers of environmental pollution [8].

The study revealed decrease in the daily weight gain, percentage weight gain, specific growth rate and survival rate (growth responses) with an increase in the concentration of Ariel, Omo and combined detergents. This corroborated with the findings of [9] and [14], who both reported that detergents reduces the growth rate of African catfish; [5], who observed reduction in growth responses of *Oreochromis niloticus* fingerlings exposed to methoxychlor; [15], who reported reduction in weight of *Clarias gariepinus*, when exposed to detergents; [16], who reported that

Table 2. Growth response of *Oreochromis niloticus* exposed to different concentrations of OMO detergent

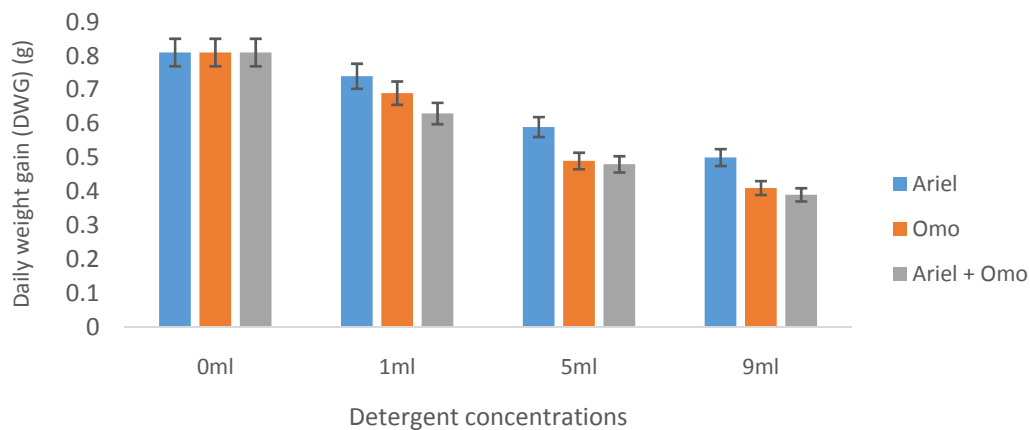
Growth parameters	Omo detergent (detergent "B")			
	0 mg/l	1 mg/l	5 mg/l	9 mg/l
Initial weight (g)	15.57 ± 1.91 ^a	16.67 ± 1.14 ^b	16.13 ± 1.45 ^c	18.11 ± 1.44 ^d
Final weight (g)	28.07 ± 1.91 ^a	28.18 ± 1.81 ^b	24.02 ± 1.49 ^c	25.48 ± 1.58 ^d
Daily weight gain (g)	0.81 ± 0.10 ^a	0.69 ± 0.03 ^b	0.49 ± 0.06 ^c	0.41 ± 0.06 ^d
Specific growth rate (SGR) (%)	1.98 ± 0.08 ^a	0.76 ± 0.03 ^b	0.58 ± 0.06 ^c	0.50 ± 0.06 ^d
Survival rate (SR) (%)	90.00 ± 10.00 ^a	56.67 ± 5.77 ^b	46.67 ± 5.77 ^c	36.67 ± 5.77 ^d
Percentage weight gain (PWG) (%)	44.73 ± 3.10 ^a	40.86 ± 1.13 ^b	32.94 ± 2.60 ^c	28.96 ± 2.77 ^d

Growth parameters are in mean ± standard deviation
 Values with different superscript are significantly different at p<0.05

Table 3. Growth response of *Oreochromis niloticus* exposed to different concentrations of combined detergent (Ariel and Omo)

Growth parameters	Ariel and OMO detergent (detergent "C")			
	0 mg/l	1 mg/l	5 mg/l	9 mg/l
Initial weight (g)	15.57 ± 1.91 ^a	16.15 ± 1.12 ^b	16.90 ± 0.50 ^c	18.67 ± 0.52 ^d
Final weight (g)	28.07 ± 1.91 ^a	26.35 ± 1.12 ^b	25.03 ± 0.81 ^c	25.87 ± 0.46 ^d
Daily weight gain (g)	0.81 ± 0.10 ^a	0.63 ± 0.04 ^b	0.48 ± 0.07 ^c	0.39 ± 0.01 ^d
Specific growth rate (SGR) (%)	1.98 ± 0.08 ^a	0.71 ± 0.04 ^b	0.57 ± 0.07 ^c	0.47 ± 0.02 ^d
Survival rate (SR) (%)	90.00 ± 10.00 ^a	50.00 ± 10.00 ^b	36.67 ± 5.77 ^c	30.00 ± 10.00 ^d
Percentage weight gain (PWG) (%)	44.73 ± 3.10 ^a	38.77 ± 1.65 ^b	32.40 ± 3.36 ^c	27.85 ± 0.77 ^d

Growth parameters are in mean ± standard deviation
 Values with different superscript are significantly different at p<0.05

**Fig. 1. Daily weight gain of *Oreochromis niloticus* exposed to different concentrations of Ariel, OMO and combined detergent**

detergents reduces fish growth, survival and affects reproductive capacity. The reduction in the growth responses compared to the control, with an increase in concentration of the Omo, Ariel and combined detergent indicates that the detergents had an adverse effect on the growth of the test fish, thereby lowering the growth rate compared to the control. The decrease in growth responses of the test fish was concentration dependent, which was in consonance with the findings of [17], who reported that the growth

response of organisms to any toxicant depends on the concentration of toxicant, chemistry of the compound and reactions of the organisms to the toxicant. The decrease in the growth responses with increasing concentrations for the Omo, Ariel and combined detergents could be due to poor feeding on the supplied food [11,5,16], increase in metabolism due to detoxification [18] and impaired health which leads to loss of appetite, energy loss due to behavioural activities during exposure [19]. This could in turn affect fish

survival, reproductive capacity [16], swimming performance [20] and metabolism [18].

The mortality of the *Oreochromis niloticus* fingerlings exposed to the different concentrations of each detergent was concentration dependent, suggesting that the fishes exposed to high concentrations of detergents suffered impairment of skin, filament and gills. This corroborated with the findings of [21], who reported that all detergents are capable of destroying the external mucus layers that protect the fish from bacteria and parasites, thereby causing severe damage to the gills; [22], who reported that synthetic detergents destroys gills, filament and causes mortality to fish due to asphyxia. The damage of the gills, causes breathing

difficulties as volumes of water current passes through them. When the test fishes were exposed to the detergents, erratic swimming, loss of equilibrium and respiratory disturbances were observed, and similar findings were reported by [14]. This could be due to respiratory impairment and damage to liver, gills, kidney, heart, skin and brain [3,22].

The daily weight gain (DWG), specific growth rate (SGR), survival rate (SR) and percentage weight gain (PWG) of *Oreochromis niloticus* for the 0, 1, 5 and 9 ml concentrations group in each detergent was highest in Ariel, and lowest in combined detergent; having a growth response sequence of Ariel > Omo > combined. This indicated that Ariel was the least toxic detergent, followed by Omo, with the combined detergent

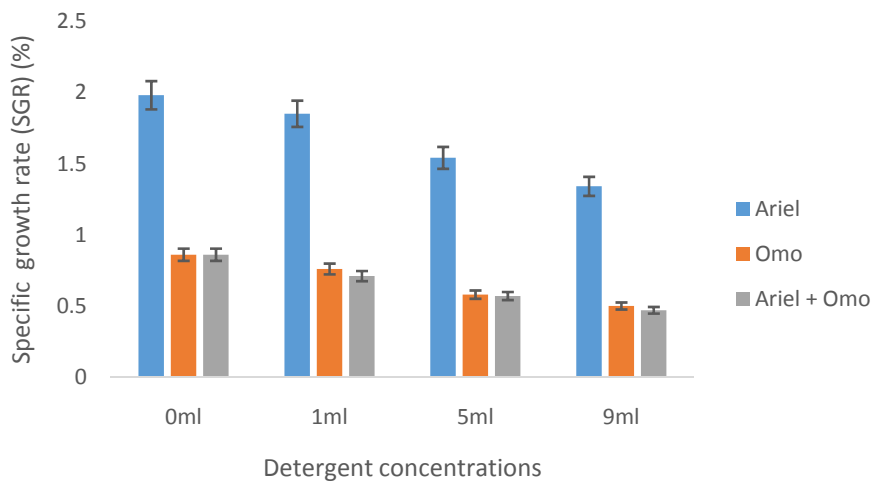


Fig. 2. Specific growth rate of *Oreochromis niloticus* exposed to different concentrations of Ariel, Omo and combined detergent

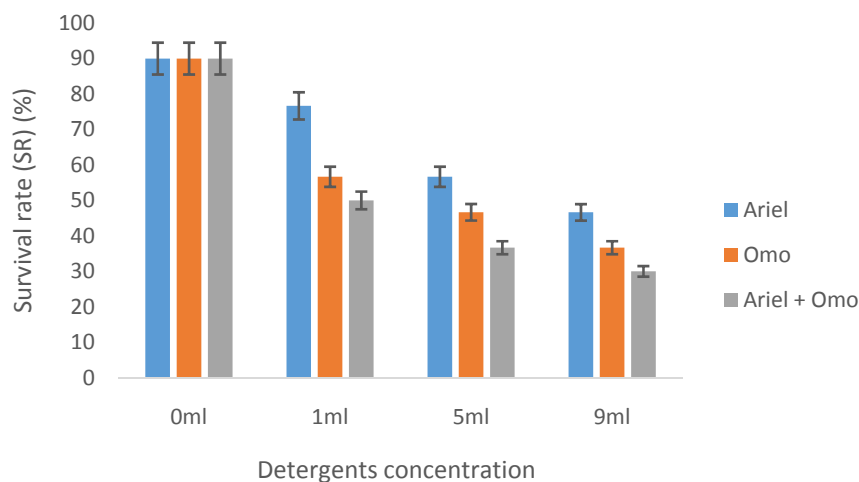


Fig. 3. Survival rate of *Oreochromis niloticus* exposed to different concentrations of Ariel, Omo and combined detergent

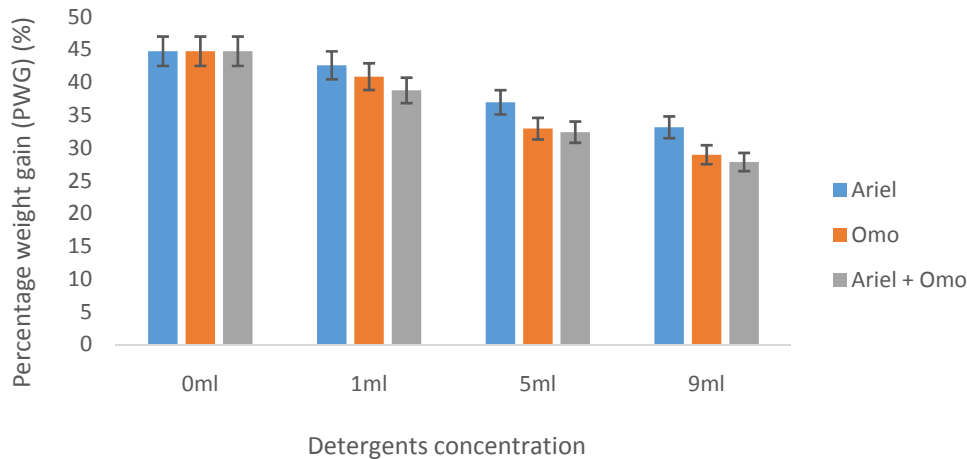


Fig. 4. Percentage weight gain of *Oreochromis niloticus* exposed to different concentrations of Ariel, OMO and combined detergent

being the most toxic. This denotes that the best fish growth aside the control group was observed in the Ariel group, but worst growth responses were observed in the combined detergent group. This corroborated with the findings of [17], who reported that the growth response of organisms to any toxicant depends on the chemistry of the compound, type of toxicants and reactions of the organisms to the toxicant.

5. CONCLUSION

The study revealed that the detergents decreased the growth parameters (daily weight gain, percentage weight gain, specific growth rate and survival rate) of *Oreochromis niloticus*, with increase in the concentration of the Ariel, Omo and combined detergents. The least toxic detergent was Ariel, while the combined detergent was the most toxic, based on their respective level of reduction of growth responses in the exposed fingerlings. The implication is that, detergents; especially combined detergent (Omo + Ariel) have an adverse effect on the growth performance of fish.

ETHICAL CONSIDERATION

The authors ensured that all the ethical and other basic principles underlying behavior and advancing welfare for the use of animals in research, including handling, relevant laws and regulations were considered before proceeding with the research.

COMPETING INTEREST

Authors have declared that no competing interests exist, but rather the research was a

collective effort of all the authors. The authors were not funded or influenced by any detergent company. The choice of detergents chosen for the study was made by the authors, because these detergents are commonly used in our country.

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