Research Article

Effect of OxyAqua Organic Product on the Growth Performance and Survival Rate of Black Fin Seabream (*Acanthopagrus berda*) and Nile Tilapia (*Oreochromis niloticus*) Juveniles Reared in Seawater Cemented Cisterns

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Abstract | In order to analyze the effects of OxyAqua organic product used for fish health management, improve water quality and high survival ratio, research was conducted for 60 days in seawater cemented cisterns at CEMB, University of Karachi. Two commercially important fish species (*Orechromis niloticus* and *Acanthopagrus berda*) were used for this study and kept in two different treatment tanks with their replicates (n=10 each) designated as T1= OxyAqua and T2= simple aeration. Juveniles were fed on supplementary pelleted diet thrice daily at 2% of their total body weight. Results showed that WG and SGR were significantly higher in T1, in which we applied Oxy Aqua organic® product without aeration than T2, whereas no significant difference (p>0.05) was found in FCR between treatments. No mortality was occurring during the whole experimental period. Comparative growth analysis of both fish species revealed that OxyAqua organic is highly suitable for enhancing the biological performance of fish in captivity. This study is recommended for intensive and semi-intensive fish cultivation technology development, water quality improvement and fish health management in aquaculture.

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Keywords | Dissolve oxygen, OxyAqua, Organic product, Intensive culture system, Growth, Survival, *Acanthopagrus berda, Orechromisniloticus*

Introduction

Aquaculture is the fastest growing industry over the last few decades to fulfill the protein requirement of human. Aquaculture can be sustained by good water quality management practices. In terms of animal health management, enhancing water quality especially dissolved oxygen (DO) concentration and productivity in aquaculture, an increasing practice of using medicines, antibiotics, disinfectants, probiotics and different chemicals can be seen to protect the aquatic animals from diseases (Das *et al*., 2020; Hossain *et al*., 2021). The commercially important fish species such as Nile Tilapia (*Oreochromis niloticus*) and Sea bream (*Acanthopagrus berda*) having a great market value worldwide (Abbas *et al*., 2015, 2019) and the industrial capability of such cultivated fish species depends on the optimal water quality because it is directly connected to the respiratory and metabolic activity of any living organism. However, hypoxic condition produce by deficiency of oxygen and causes mass mortality with reduce production in aquaculture. Even though, failure to maintain oxygen level in any captive environment causes parasitic infection or other fatal diseases (Collins, 1994; Wedemeyer, 1997; Falahatkar *et al*., 2009; Michael *et al*., 2019). It is also noted that fish is not able to consume their food and having low immunity when dissolved oxygen level is low, therefore, a satisfactory level of dissolved oxygen are crucial for healthy aquatic life (Olsvik *et al*., 2006; Mallya, 2007; Diaz Pauli *et al*., 2017). In aquaculture, the process of mixing air in water to increase the dissolved oxygen content is called aeration. Artificial aeration with different methods is the best source for protecting various disease problems because artificial feeding will lead to increased pollution and carbon dioxide level in the water with decrease dissolved oxygen (Agarwal, 1999; Boyd, 1995). Artificial aeration through various aerator machine is the common and reliable method applied in intensive and semi-intensive aquaculture system (Boyd, 1990; Timmons *et al*., 2001; Ritola *et al*., 2002; Valverde *et al*., 2006), but currently using an organic products known as Aci-Ox, OxyAqua, Oxy-A, Oxyflox, Oxymax, Oxyren, Oxymore, and Oxylife are crucial to optimize the dissolve oxygen level and fertility of water in any culture system to get maximum yield with high survival ratio (Adhikary *et al*., 2018; Das *et al*., 2020; Hossain *et al*., 2021).

Therefore, our aim of the present study is to analyze the overall growth performance and their effects on two most commercial fish species (*Orechromis niloticus* and *Acanthopagrus berda*) by using two different artificial methods for obtaining sufficient dissolve oxygen concentration in captivity.

Materials and Methods

Juveniles of Nile Tilapia, *Oreochromis niloticus* and Seabream, *Acanthopagrus berda* (35-38g and 12-14cm) were captured from the wild through the cast net and brought back with full aeration system into aquaculture laboratory (CEMB, University of Karachi). Juveniles were immediately shifted into new tanks for up to fifteen days to acclimatize. Randomly selected ten juveniles were placed in each cemented tanks (1000 liter) with two replicates and provide floating pelleted feed (Table 1) thrice daily (five hour interval) at 2% body weight for 60 days. Two types of treatment system were designated as OxyAqua without aeration (T1) and common aeration system (T2). The OxyAqua organic® product is specifically used for increasing the fertility of water and maintain a healthy dissolve oxygen concentration for long term. 1ml OxyAqua was used in 150 liters of water and disperse evenly over the surface of tank. We applied OxyAqua biweekly when 30% of water change. After every 12 days of trial, we were gathered juveniles from each treatment tank with the help of scoop net and noticed the total length (cm) and weight (grams) by the assistance of digital weight balance machine and immediately released back into their respective tanks.Growth indices were used to calculate the overall growth performance of fish during the whole experimental period (Abbas *et al*., 2019).

Table 1: *Ingredients and chemical composition (%) of the experimental diet.*

Ingredients (%)	**DM (%)**
Soybean meal	15
Mustered oil cake	15
Fishmeal	10
Rice bran	20
Maize Gluten	10
Wheat bran	10
Tapioca	8
Vitamin and mineral premix	5
Fish oil	7
Total (%)	100 (%)
Chemical analysis (%)	
Moisture	10
Crude protein	38.7
Crude lipid	4.4
Crude fiber	8.6
Ash	12

Water quality parameter were monitored daily, such as temperature (°C) via digital thermometer, salinity (‰) with refractometer, pH with pH meter, ammonia (mg/L) and dissolved oxygen (ml/L) with portable test kit (Merck, Germany).

Statistical analysis was done through ANOVA and Duncan's multiple range test suggested by Steel *et al*. (1997). The data are presented as mean±SE of the duplicate groups.

Results and Discussion

Feed consumption and growth

After finish the trial, all fish were collected and measure length (cm) and weight (g) to calculate the overall growth rate among all treatments. The weight gain was significantly ($p<0.05$) higher in T1 (41.08±0.01g and 44.31±0.43g) for both Nile Tilapia and black fin seabream than in T2 (37.12±0.02g and 40.44±0.42), respectively (Table 2). We also obtained significantly higher ($p< 0.05$) results in terms of SGR and WG% by using OxyAqua than in treatment 2, whereas, no significant difference ($p>0.05$) was found in FCR between treatments. Fish were active and alive with 100 % survival rate among all treatments during the whole study periods as shown in Table 2.

Table 2: *Growth performance of Tilapia Nilotica (Oreochromis niloticus) and black fin seabream (Acanthopagrus berda) on different rearing systems for 60 days.*

Parameters	*Oreochromis niloticus*		*Acanthopagrus berda*	
	T1 (OxyAqua)	T2 (Aeration)	T1 (OxyAqua)	T2 (Aeration)
IW (g)	38.02±0.01^{a}	37.82±0.02^{a}	35.51±2.4^{a}	35.23±2.9^{a}
IL (cm)	14.01±0.02^{a}	14.41±0.01^{a}	12.83±0.07^{a}	12.42±0.13^{a}
FW (g)	78.6±0.14^{b}	74.94±0.15^{a}	79.82±1.7^{b}	75.67±2.5^{a}
FL (cm)	16.58±0.03^{b}	15.79±0.02^{a}	14.35±0.2^{ab}	14.44±0.13^{ab}
WG (g)	41.08±0.01^{b}	37.12±0.02^{a}	44.31±0.43^{b}	40.44±0.42^{a}
SGR	1.6±0.01^{b}	1.4±0.01^{a}	1.5±0.01^{b}	1.3±0.02^{a}
WG% IW	106.9±2.6^{b}	98.14±1.4^{b}	124.78±0.05^{b}	114.78±0.12^{a}
FCR	1.55±0.01^{a}	1.60±0.01^{a}	1.47±0.02^{a}	1.56±0.02^{a}
Survival	100±0.0	100±0.0	100±0.0	100±0.0

IW= Initial weight, IL= Initial length, FW= Final weight, FL= Final length, WG= Weight gain, SGR= Specific growth rate, WG% IW= Weight gain percent of initial weight and FCR= Feed conversion ratio. Values with similar superscripts in a row are not significantly (P>0.05) different.

Growth comparison

Initially the growth of fishes in both treatments (T1 and T2) showed no significant difference ($p>0.05$) till 3 weeks of trial but Treatment 1 for both species shows slightly higher results in 4th week of the experiment due to the use of OxyAqua product that enhance the water quality and produce a healthy environment for the development of fishes as compared to T2 in which we used common artificial aeration system that temporarily adds oxygen and then dissolved in a water (Figure 1 and 2).

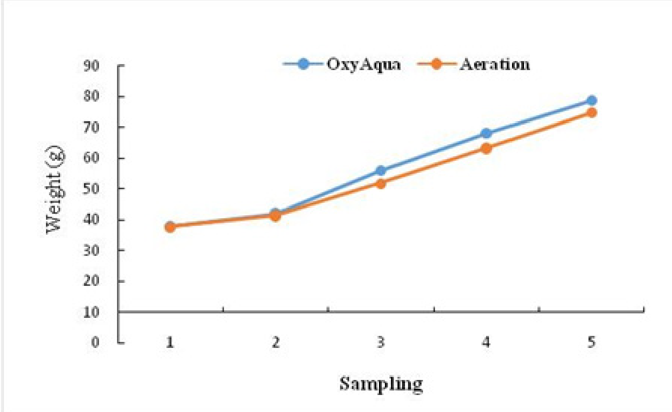

Figure 1: *Comparative growth of Tilapia nilotica (Oreochromis niloticus) on two treatments (T1=OxyAqua and T2= aeration).*

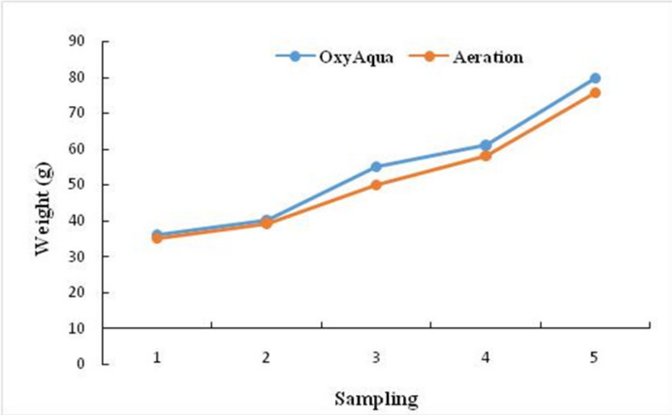

Figure 2: *Comparative growth of black fin seabream (Acanthopagrus berda) on two treatments (T1=OxyAqua and T2= aeration).*

Table 3: *Water quality parameters of experimental tanks for the duration of 60 days.*

Parameters	Treatment-1	Treatment-2
Temperature (°C)	28.35±0.47^{a}	27.55±0.57^{a}
pH	7.0±0.32^{a}	8.1±0.41^{b}
Dissolved Oxygen (ml/L)	8.15±0.23^{b}	6.8±0.17^{a}
Salinity (‰)	25.15±0.04^{a}	25.25±0.08^{a}
Ammonia (mg/L)	0.027±0.01^{a}	0.025±0.02^{a}

**Mean value ±S.E. Values with similar superscripts in a row are not significantly (P>0.05) different.*

Water quality

In the present study, water quality parameters were shown in Table 3. The water temperature was ranged from 27.7 °C to 27.9 °C, pH was ranged from 7.1 to 8.3, dissolved oxygen was observed between 6.2 to 8.9 ml/L in both treatments and ammonia was found 0.031 to 0.033 mg/L. Salinity (18 to 28‰) were kept similar in both treatments. The results mentioned that all the parameters of water were found tolerable and suitable for the survival of fishes during the whole experimental period.

Various types of commercial aqua-products have been used in aquaculture and become an essential input for successful fish production globally, also improving soil and water quality, enhancing natural productivity, dissolve oxygen (DO) concentration and lower harmful gasses in ponds (Islam, 2022). Generally, successful aquaculture depends on the good water quality especially an optimum oxygen concentration in the ponds and worldwide many farmers were used different chemical products such as Oxymax, Oxymore, Oxylife, Aci-ox, Oxyrich Tab, Oxygold, Oxy-aqua, Oxy-A, Oxyflox and Oxyren to enhance dissolved oxygen concentration of water (Adhikary *et al*., 2018; Das *et al*., 2020; Hossain *et al*., 2021). Due to this reason, in our study we used different media such as OxyAqua medium in T1 and artificial aeration system in T2 to observed the overall growth of Nile Tilapia (*Oreochromis niloticus*) and blackfin seabream (*Acanthopagrus berda*) in seawater cemented tanks. Fishes were fed supplementary diet at 2% of their total BW with the feeding frequency of thrice daily for 60 days. Similar feeding frequency have been observed for red tilapia (Hybrid) and Nile tilapia *Oreochromis niloticus* by (Daudpota *et al*., 2014; 2016; Malik *et al*., 2018, 2019). Similarly, Rahim *et al*. (2017) mentioned that juveniles that feed less i.e., one or two time instead of three times a day showed lower growth performance because sufficient feed is necessary to maximize the growth of juveniles. Whereas, Cho *et al*. (2003) and Abbas *et al*. (2015) have already described that overdose of feed (4 times/day) may deplete the feed and cause no further growth in terms of weight gain. But it can be vary species to species, body size and type and feed ingredients because some fishes have fast metabolic rate and need more nutrients than others (Company *et al*., 1999; Lee *et al*., 2000; Craig and Helfrich, 2002; Ashley-dejo *et al*., 2014).

In this study, OxyAqua organic product (T1) used for adequate DO level and to analyze the effects on the biological performance of two commercially important fish species (Nile Tilapia and black-fin seabream) and found good results in T1 (WG = 41.08 ± 0.01g and 44.31 ± 0.43g, orderly) as compared to simple aeration in T2 (WC= 37.12 ± 0.02g and 40.44 ± 0.42g, respectively) in captivity. Many studies recommended the optimal oxygen saturation level between 80% and 120% for the best growth performance and feed conversion ratio on Atlantic halibut (Mallya, 2007), while, in red tilapia by Tsadik and Kutty (1987), in Nile tilapia (*Oreochromis niloticus*) by Abdel-Tawwab *et al*. (2014) and in Atlantic salmon by Forsberg and Bergheim (1996). Another study revealed that dissolved oxygen (DO) is one of the important parameters of pond water which requires continuous monitoring in aquaculture systems. Additionally, appropriate levels of dissolved oxygen (DO) are highly crucial for all aerobic life forms. The decline in DO concentration causes hypoxic condition in water that lead to great stress on fish, decreases growth and mortality (Abdel-Tawwab *et al*., 2019; Wood *et al*., 2019). Increasing the level of DO also increases the growth rate of fish. Fish need oxygen to produce energy: This energy can be used in movement and another process of biosynthesis (Van Dam and Pauly, 1995). There is evidence that optimal oxygen levels can improve fish growth (Foss *et al*., 2003; Dabrowski *et al*., 2004; Person-Le Ruyet*et al*., 2002). Another study summarizes that large fish are extremely well tolerated in a low level of dissolved oxygen (DO) as compared to small fish, because the appropriate dissolve oxygen concentration increases the metabolism, food consumption and natural immunity (Akhter *et al*., 2015). In addition, Bergheim *et al*. (2006) reported that the growing and dietary productivity of fish were affected by the availability of DO, and that fish continuously exhibited virtuous dietary productivity when nourished with sufficient level of Oxygen in water. Evidence to support this study was reported by (Swingle, 1968; Grizzell *et al*., 1969; Mayer and Eschmeyer, 1973; Thorarensen *et al*., 2010).

The water quality range in current study was suitable for the survival of Nile tilapia and seabream fish species and similar range were mentioned during the experimentation on hybrid red tilapia (*Oreochromis niloticus* × *O. mossambicus*) and Nile tilapia (*O. niloticus*) by Daudpota *et al*. (2014, 2016), Shah *et al*. (2014), Narejo *et al*. (2003, 2005, 2010), and Malik *et al*. (2018, 2019). Although, Boyd (1990) reported that water quality especially adequate dissolved oxygen (DO) level also useful for oxidizing ammonia to nitrate and maintain the healthy pH level in water. The survival ratio of fishes in this study were remained same (100%) in both treatments (T1 and T2) as also described by (Daudpota *et al*., 2014; Saeed and Al-Nagaawy, 2013; Maniruzzaman, 2001).

Conclusions and Recommendations

In conclusion, OxyAqua organic product is suitable for adequate oxygen concentration in the water without an artificial aeration system. In our experiment the Nile tilapia (*O. niloticus*) and black fin seabream (*A. berda*) juveniles were reared in two medium and showed higher growth in T1 (OxyAqua medium) rather than common aeration system (T2). In aquaculture the aqua-products are extremely useful for maximum sustainable yield and production but to analyze their effects on aquatic species is highly recommended. In future we will conduct more research in order to identify the different optimal concentration of OxyAqua and their effects on the biological performance of other commercially important species in seawater ponds.

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Novelty Statement

The current study investigates the biological performance of two commercially important fish species (*Oreochromis niloticus* and *Acanthopagrus berda*) by using two different medium in seawater cemented cisterns.

Author's Contribution

Javeria Khourshid: Performed the experiment and prepared the initial draft.
Ghulam Abbas: Supervised, data analysis and helped in experimental setup.
Asma Fatima: Reanalyze the data, edited and finalize the manuscript writing.
Abdul Malik: Look after, record and analyze the experimental data.
Shahnaz Rashid: Reviewed the final version of manuscript.

Conflict of interest
The authors have declared no conflict of interest.

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