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Effect of Different Water Sources on Survival Rate (%) Growth Performance, Feed Utilization, Fish Yield, and Economic Evaluation on Nile Tilapia (*Oreochromis niloticus*) Monosex Reared in Earthen Ponds

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Abstract

The aim of the present study was to investigate the effect of water source on survival rate %, growth performance, feed utilization, fish yield, economic evaluation and production of Nile tilapia (*Oreochromis niloticus*) monosex reared in earthen ponds. Nine earthen ponds were used and divided into three categories of three earthen ponds each. The average size of each pond was approximately 5200m2, 6000 monosex all male Nile tilapia were used in each pond and were stocked for 192 days. The fingerlings average weight was 4.38±0.03g/ fish, the fish were fed using a floating feed 25% crude protein, and were fed at a daily rate of 3% of their body weight. Results showed that body weight was increased significantly (P<0.05) with well water to 472.33g/fish. While were 354.17 and 320.17g/fish for fresh and agricultural drainage water, respectively. Specific growth rates (SGR%) increased with well water compared to both fresh and drainage water. Feed conversion ratio (FCR) and protein efficiency ratio (PER) were improved with Agriculture drainage water. Survival rates with fresh and well water were 98.53% and 98.31% respectively, however, was 95.05% with Agriculture drainage water. Total fish yield were affected significantly by treatments. It was 2128, 1921.8, and 2837.7kg at fresh, drainage and well water respectively. Net return arrived to 12996 for well water source when it was 6784LE for agricultural drainage water and 9158LE for fresh water.

Keywords: Water resources; Nile tilapia; Growth per

Introduction

Nile tilapia, *Oreochromis niloticus* (Linnaeus) is one of the most important freshwater fish in world aquaculture [1]. It is widely cultured in many tropical and subtropical countries of the world [2]. Rapid growth rates, high tolerance to adverse environmental conditions, efficient feed conversion, ease of spawning, resistance to disease and good consumer acceptance make it a suitable fish for culture [3]. Farmed tilapia production increased semi dramatically in recent years, increasing from 383,654mt in 1990 to 2,326,413mt in 2006 [4]. Tilapia has established a secure position in a number of water impoundments of India. But, its performance in open water ponds of the country has been discouraging over the years [5]. For tilapia aquaculture is excessive reproduction and the resulting small size of the fish produced.

Egypt has suitable natural conditions for desert aquaculture. Egypt has vast resources of groundwater [6]. Fresh groundwater resources in Egypt contribute 20% to the potential water resources in Egypt. One of the groundwater resources is the Nile Valley and Delta system with the storage capacities of 200 billion m^3 and 300 billion m^3, respectively. Oasis water in the west desert, Bahariya, Farafra, Dakhla, Kharga, and Siwa, were established from underground natural wells and springs.

With the prohibition of the establishment of fish farms on agricultural land, with the prohibition of the use of Nile water for fish farming, with increased competition for spaces adjacent to the lakes and sources of agricultural drainage water, despite its disadvantages, has caused the possession of new fish farm in the Nile [7]. Valley of the most difficult things and out of reach. Hence the search for an alternative to invade the desert, especially with the development of methods of fish farming and providing the requirements of education and with the provision of underground water of the highest purity with different salinity (fresh & brackish & marine) and where the trained professionals are available [8]. In the hope to produce clean fish with improved quality and cheaper than other animal proteins we conducted the present research in a private fish farm located in the desert belonging to Noubaria Agricultural Development company (Ragab Farms) aiming to study the effect of water source on survival rate (%) growth performances, feed conversion ratio, protein efficiency ratio, annul fish yield and profitability Nile tilapia (*Oreochromis niloticus*) monosex commercial farming.

Material and Methods

Water Source

Three types of water sources: fresh water, agricultural drainage water, and well water were compared in the present experiment. Water supplies were replaced three times during the experimental period (192 days).

Experimental design

Nine earthen ponds (5200m^2) were used in these experiment were divided into three categories of earthen ponds even three ponds represent one treatment (fresh water, drainage water and well water.

Stocking density

6000 monosex all male Nile tilapia (*Oreochromis niloticus*) fingerlings of average weight (4.38±0.03g/ fish) were stoked in each pond on April 11, 2007 and observed through October 19, 2007. The area of each pond 5200m^2.

Experimental Fish

Fingerlings of all male Nile tilapia (*Oreochromis niloticus*) monosex were collected from Noubaria Agricultural Development Company (Ragab Fish Hatchery) and were over wintered in earthen ponds to provide suitable fingerlings for the beginning of the growing season. All ponds in this experiment were sampled monthly using a cast net method. Sample sizes were 1% of the stocked numbers and the average individual fish weight was calculated to determine growth rates. Then, with these calculations, the feed amounts were adjusted for the following month.

Experimental diet

The floating commercial diet used in this experiment was fed at a daily rate of 3% of the fish body weight by using self feeders The ingredients of the commercial diet used in the experiment is presented in (Table 1). The dietary composition of vitamin and mineral premix is listed in. Fish were fed a floating ration for 6 days per week. Feeding rate was adjusted monthly based upon the calculated biomass of fish obtained through the monthly sampling and assumption of 100% survival.

Water quality

Physical parameters: Water temperature °C was determined at every days in the experiment.

Chemical Parameters: Samples for determination of dissolved oxygen (DO) were immediately fixed after sampling and DO concentration was determined according to Winkler's technique. Methods described by Golterman et al. [9] were used in determination of ammonia. Also pH was measured by digital pH meter (Orion model 720 A, s /No 13602) in all experiments.

Chemical Analysis of the commercial of Diet: Chemical analysis of the commercial diet used in the experiment was done according to AOAC (2000) as shown in Table 1.

Growth parameters and Statistical analysis: Data on growth, feed utilization, survival rate and proximate and chemical composition of whole fish body were subjected to one-way ANOVA [10]. To locate significant differences between fish size within different water resources of pond. Duncan's multiple rang test [11] was done. All percentages and ratio were transformed to arcsine values prior to analysis [12].

Results and Discussion

Experimental diet

The commercial diet used in the present experiment contained 25% CP and 4.3kcal/g gross energy (Table 1). Although there are large variations in the data available about the optimum protein level for tilapias which range between 20 and 40% crude protein [13-15] practical diets as low as 25% protein was successfully used for rearing monosex tilapia [3].

Table 1: Composition and proximate composition of control and the experimental diets for feeding Nile tilapia.

Ingredients (%)	Diet
Fish meal	10
Meat meal	10
Soybean meal	16
Wheat bran	20
Yellow corn meal	38
Corn oil	3
Bone meal	1
Vitamin mixture	1

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Minerals mixture	1
Proximate composition (%)	
Dry matter	90.65
Crude protein	25.12
Ether extract%	5.9
Ash	7.41
Crude fiber	4.4
NFE4	56.17
Goss energy kcal/g	4.3

Vit. A 8000 I.U. Vit. D3 4000 I.U.; vit. E 50mg; Vit. k3 19mg;

Vit. B1 40mg; vit. B2 25 mg; Vit. B6 125mg; vit B12 69mg;

Pantothenic acid 40mg; Nicotinic acid 125mg; Folic acid 400mg;

Water quality

Collected data on water temperature and dissolved oxygen (DO), pH and ammonia are summarized in Tables 2-4. Water temperature throughout the present experiments ranged between 24.13±0.53 and 30.26±0.45 °C in fresh water experiment, 24.23±0.53 and 30.65±0.53 °C in drainage water experiment and between 29.94±0.12 and 33.63±0.43 in well water experiment which was the high temperature and closely related to the average of optimal value for tilapia (28-30 °C). Our results were agreement with Broussard [16] reported that tilapia as a warm water fish that dominate African lakes, are known to grow well in high temperature. The fluctuation of water temperature are reached its maximum values during August, however its minimum were during April and November.

Table 2: Water quality parameters (Mean±SE) of fresh water, drainage water well water during 8 months of The experimental period (April to November 2008).

*Duration Months	April	May	June	July	August	September	October	November
Fresh Water								
Ammonia mg/l	0.09±0.01	0.11±0.01	0.12±0.01	0.12±0.01	0.12±0.01	0.11±0.01	0.09±0.01	0.12±0.01
Ph	7.98±0.13	7.98±0.13	8.00±0.13	8.00±0.13	8.00±0.13	8.00±0.13	8.00±0.13	7.98±0.13
D Oxygen mg/l	6.58±0.92	6.83±0.61	6.82±0.56	7.33±0.09	7.08±0.53	7.33±0.09	7.37±0.09	8.33±0.09
Temperature	25.4±0.12	26.2±0.14	28.9±0.67	29.6±0.43	30.3±0.45	28.4±0.62	26.9±0.13	24.13±0.53
DRAINAGE WATER								
Ammonia mg/l	0.10±0.01	0.10±0.01	0.11±0.01	0.11±0.01	0.13±0.01	0.13±0.01	0.12±0.01	0.11±0.01
Ph	8.01±0.13	8.03±0.13	8.04±0.13	8.06±0.13	8.10±0.13	8.09±0.13	8.06±0.13	8.06±0.13
D. Oxygen mg/l	6.56±0.90	6.80±0.60	6.82±0.58	7.31±0.08	7.07±0.52	7.33±0.09	7.34±0.08	8.33±0.09
Temperature °C	25.98±0.1	26.60±0.2	29.04±0.8	30.29±0.4	30.65±0.5	28.48±0.7	27.28±0.1	24.23±0.5
WELL WATER								
Ammonia mg/l	0.06±0.01	0.07±0.01	0.08±0.01	0.08±0.01	0.10±0.01	0.09±0.01	0.08±0.01	0.06±0.01
Ph	8.00±0.13	8.02±0.13	8.04±0.13	8.05±0.13	8.10±0.13	8.08±0.13	8.04±0.13	8.00±0.13
D Oxygen mg/l	6.07±0.52	6.22±0.58	6.31±0.08	6.52±0.60	6.56±0.90	6.34±0.08	6.33±0.09	6.33±0.09
Temperature °C	9.94±0.12	30.82±0.14	0.85±0.67	32.46±0.4	3.63±0.43	33.38±0.62	32.88±0.1	31.63±0.53

*Each value was on average of four sub samples

Biotin 20mg; cholin chloride 80 mg; copper 400mg; Iodine 40mg;

Iron 120mg; Manganese 220mg; Zink 22mg; Selenium 4mg

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Table 3: Effect of water source on growth performance of Nile tilapia monosex during the experimental period (days).

s	Body Weight (g)		Daily Gain (g)	SGR	FCR	PER
	Initial	Final				
Fresh water	4.38±0.03	354.2±14.42[b]	1.82±0.07[b]	2.27±0.02[b]	2.87±0.00[a]	1.38±0.00[c]
Drainage water	4.35±0.08	320.2±19.47[b]	1.64±0.10[b]	2.22±0.02[b]	2.80±0.00[c]	1.42±0.00[a]
Well water	4.36±0.07	472.3±2.92[a]	2.44±0.01[a]	2.43±0.00[a]	2.83±0.00[b]	1.40±0.00[b]
LSD(P<0.05)*	NS	42.5	0.22	0.06	0.02	0.01

Means in the same column having different letters are significantly different (P<0.05).

Table 4: Effect of water source, pond sizes stocking density on yield and survival rate (%) of tilapia monosex.Means in the same column having different letters are significantly different (P<0.05).

Item	Total Yield		Survival %
	Kg	%	
Water source			
a) Fresh water	2128±86.43[b]	100	98.53±0.05[a]
b) Drainage water	1921.8±116.96[b]	90.31	95.05±0.3[b]
c) Well water	2837.7±.617[a]	133.34	98.31±0.42[a]
LSD (P<0 05)	255.01		0.91

Overall means of water dissolved oxygen (DO) throughout the present experiment were 7.20±0.37mg DO/I for fresh water, 7.19±0.36mg DO/I for drainage water and 6.33±0.36mg DO/I for well water. The fluctuation of water dissolved oxygen (DO) showed that the maximum values of DO were obtained in November for the fresh and drainage water and August in well water, however, the lowest values were in April. In general, dissolved oxygen levels were within the high standards and higher than cited by Boyd [18] for good production of tilapia (4.20 to 5.90mg DO/I) in aquaculture ponds. One of the most important environmental factors is dissolved oxygen. It is considered a limiting factor for success or failure in intensive culture. An excellent aquaculture attribute of tilapia is their tolerance to low dissolved oxygen concentration [16]. The dissolved oxygen content in earthen ponds depends on the pond water temperature, fish biomass and rate of water exchange [18]. Chervinski [19] reported that *O. niloticus* survived short term exposure to 0.1mg DO/ l. However, Collins [20] observed in a review on oxygen concentration of various studies, that growth rate of non-salmonid fish was increasingly depressed as dissolved oxygen fall below 50% saturation. Rappaport et al. [21] reported that growth of carp was reduced by predawn dissolved oxygen less that 25% saturation. Tichert-C & Green [22] compared the growth of tilapia monosex in earthen ponds aerated or unaerated at 10 or 30% saturation of dissolved oxygen. They found that tilapia production and final weight were significantly greater in aerated ponds than unaerated ponds.

The water pH values throughout the present experiments ranged between 8.00±0.13and 8.10±0.13 with an overall mean of 8.04±0.13 in fresh water and ranged between 8.01±0.13 and 8.10±0.13 with an overall mean of 8.05±0.13 in drainage water and ranged between 7.98±0.13and 8.01±0.13 with an overall mean of 8.00±0.13 in well water. The fluctuations of pH reach the highest value of 8.10+0.13 during August in fresh and drainage water and 8.01+0.13 in well water. The results showed that the present pH values are suitable. For rearing tilapia monosex in earthen ponds. Johnson [23] recommended the range of pH 6.5 to 9.0 for most of freshwater fish species.

The water un-ionized ammonia (NH3) throughout the present experiments ranged between 0.09±0.01 and 0.12±0.01 with an overall mean of 0.11±0.01 in fresh water and ranged between 0.10±0.01 and 0.13±0.01 with an overall mean of 0.11±0.01 in drainage water and ranged between 0.06±0.01 and 0.10±0.01 with an overall mean of 0.077±0.01 in well water. The fluctuations of un-ionized ammonia reach the highest values of 0.13mg/ l during August. Unionized ammonia concentrations in the experimental ponds generally remained below levels which would cause chronic toxicity problems in tilapia. Tilapia is more tolerant to elevated levels of ammonia than more other sensitive species such as salmonids [23]. Some tilapias have been shown to acclimate to higher levels of ammonia after chronic exposure to low levels [24]. Johnson [23] showed that levels of un-ionized ammonia which may adversely affect growth in tilapia range from 1mg/ l to 2mg/ l ammonia where temperature and pH are within normal range.

Growth performance of tilapia monosex

Mean weight: Results of the present study showed that the mean weights at all rearing intervals different significantly (P<0.05) during all the experimental periods (Table 5 & Figure 1). Averages of fish body weights for fresh water, drainage water and well water were found to be 23.16, 18.66 and 25.16g, respectively after the 1st month of stocking. The statistical evaluation of results indicated that live weights at this period increased significantly (P<0.05) with using well water. A similar trend was also observed in fish body weights during the other

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growing periods. At harvest average body weight of fish stocked at well water was significantly (P<0.05) higher than that of fish stocked in fresh or drainage water, which indicates that weights fish were decreased in fresh and drainage water with increasing for used well water at harvest were 354.17g, 320.17g and 472.33g for fresh, drainage and well water, respectively. This significant advancement in fish body weights with increasing at higher temperature of water advocated by Azaze et al. [25] reported that the final mean weight was significantly higher at 26 and 30 °C than at 22 and 34 °C. This finding agrees with our results.

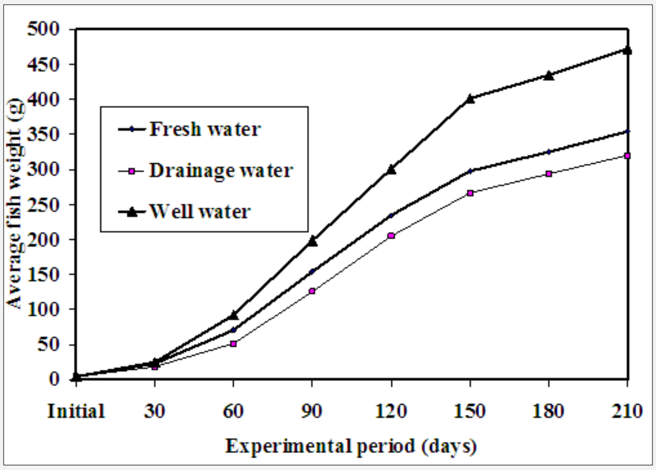

Figure 1: Effects of water source on fish growth.

Average daily gain (ADG g/day): Results presented in Table 5 revealed that water sources, affected significantly (P<0.05) ADG during all experimental periods tested (30, 60, 90,120,150,180 and 210 days after start). In general these results indicated that the well water favored significantly ADG of the tilapia monosex in intensive culture system. The results of this point were in agreement with those found by [17] who grew *O. niloticus* from 49g to 271g in 122 days (1.4%/day). Siddiqui et al. [15] found that ADG of tilapia O. niloticus reared for 98 days at different water exchange in outdoor concrete tanks was 1.06g / day at 30% dietary crude protein. In the present study the average daily gain was higher with 25% crude protein at all treatments. However, the optimal feeding rate depends on fish size and **Specific Growth Rate (SGR %):** Results presented in Table 5, revealed that water sources, affected significantly (P<0.05) SGR% during all experimental periods tested (30, 60, 90,120,150,180 and 205 days after start). In general these results indicated that the well water, favored significantly (P<0.05) SGR% of the tilapia monosex in intensive culture system.

During all tested experimental periods tested (30, 60, 90,120,150,180 and 205 days after start) SGR% increased significantly (P<0.05) in almost linear manner in the well water than fresh and drainage water In the present study SGR% values in case of well water continuously higher than fresh or drainage water in all experimental periods. This may be due to the higher temperature of the well water (average 31.94 °C) compared to 27.47 and 27.81 °C for fresh and drainage water, respectively. The results obtained in SGR% are in agreement with those found by Eid & El Denasoury [27] who indicated that increasing temperature from 16 °C to 27 °C improve growth rate of Nile tilapia, which using well water.

Feed conversion ratio (FCR): Results presented in Table 5, show that there were significant (P<0.05) effects of water sources on FCR, feed conversion ratio was observed at harvest was 2.87 at fresh water, followed by 2.83 at well water and 2.80 at drainage water and 2.94 for 1700m2 followed by 2.89 for 4000m2 followed by 2.75 for 5200m2 and was 2.57 for 6000 fish/ acre, 2.75 for 8000 fish/ acre and 2.78 for 10000 fish/ acre. The analyses of variance of the FCR values are presented in Table 5. The FCR is affected by the physiological state of the fish, environmental condition, [28]. Lovshin et al. [29] found that FCR for all male tilapia in earthen ponds was higher (4.3) than when compared with all male and female tilapia in earthen ponds (FCR=7.2). while, fish growth is affected by the amount of feed consumed and the efficiency of assimilation [30].

Protein efficiency ratio (PER): Results of protein efficiency ratio (PER) are presented in Table 5, There were significant (P<0.05) effects of water sources, on PER, it improved significantly (P<0.05) with each increase in pond sizes and decrease stocking density throughout the experimental periods. The best PER observed at harvest was 1.42 with drainage water, followed by 1.40 at well water and 1.38 at fresh water Nyina-W et al. [31] confirmed that when protein supply is appropriate (400–500g protein/kg feed for percid fish), different lipid contents in feeds do not have an impact on the rearing results of pikeperch.

Fish survival rate: Results in Table 6 showed that survival rates were changed significantly (P<0.05) by water resources, in fresh and well water were insignificantly (P<0.05) different but survival of the fish in drainage water was 95.05% which was less than survival rates in both fresh water and well water indicating the probable effect of some faction of water quality.

Fish yield: Results of Table 4 show fish yield (kg) per acre as affected by water sources,. Results revealed that total yield increased significantly (P<0.05) with well water. The total production was found to be 133.34% and 90.31% for well water and drainage water, respectively, while it was found to be 76.33% and 68.84% for 4000m^2 and 5200m^2.

The results of the present experiment were similar to those of Tal & Ziv [32] who showed that the net yield of tilapia monosex in earthen ponds was 16750Kg /ha (7035.0kg/ acre) after 100 days of stocking of 80.000 fish/ha, (33600 fish/acre, 8 fish/m^2) on the other hand Eid & Denasoury [27] indicated that increasing temperature from 16 °C to 27 °C improved growth rate of Nile tilapia. Watanabe et al. [33] found that growth rates generally increase with increasing temperature and where markedly lower at 22 °C and well water is the best because the temperature constant through the year and the best quality of the water. [34] found the higher yield obtained in small pond

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sizes because the bigger ponds with greater surface area were more difficult to manage and often resulted in lower fish yields.

All fish species are characterized by an ideal range of temperature in which they show their maximum growth [35-37]. Several studies have been reported that the specific water temperature range showed the faster growth in Pikeperch, Sander lucioperca at 20 °C to 25 °C [38-40]. Low temperature causes sluggishness by retarding the digestion speeding of fish [41]. Some researchers have found that the digestion rate has been increased as the temperature increases [42]. Environmental temperature is one of the most important ecological factor which also influence the behavior and physiological process of aquatic animals [43].

One of the major advantages of groundwater sources is their constant temperature throughout the year. Shallow sources of groundwater approximate the mean air temperature of the area. The chemistry of groundwater is directly dependent on the geology of the area surrounding the source. In limestone areas, groundwater is hard, and high in calcium and carbon dioxide [44]. In areas of granite formation, the groundwater tends to be soft, low in dissolved minerals and carbon dioxide. As will be discussed later, there are advantages and disadvantages to both, emphasizing the need for early extensive water quality testing.

Water temperature has substantial effect on fish metabolism. In response to decreasing of water temperature the enzyme activity of tissues have been increased [45]. Velmurugan et al. [46] have investigated that histopathological and tissue enzyme changes of C. gariepinus exposed to nitrite when water temperatures changes from 27 °C to 35 °C. In a stressful and unfavorable environmental condition GPT and GOT may increase in blood serum. In the present study serum GPT and GOT level were affected by different water temperature. Serum GPT and GOT amount in different fish fed at 20 °C are comparatively lower than those of fish fed at 16 °C and 24 °C experiments (Tables 1-3). These results indicated that 20 °C may be a favorable water temperature for better growth of 16g juvenile Korean rockfish [47,48].

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