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# EFFECTS OF DIFFERENT LEVELS OF COMMERCIAL PRODUCT OF PROBIOTIC AND STOCKING DENSITY ON GROWTH PERFORMANCE, SURVIVABILITY AND FEED UTILIZATION OF MONOSEX NILE TILAPIA *(OREOCHROMIS NILOTICUS* L.*)* FRY DURING THE REARING PERIOD

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## *Abstract*

This study was carried out to investigate the effects of different levels of probiotic (Super biobuds) supplemented to the diet as a natural growth promoter and either under low or high density on growth performance, survival rate, feed utilization, total fingerlings production and economical efficiency for Nile tilapia *Oreochromis niloticus* during a single-stage nursery-rearing system. Four experimental diets were formulated to contain 0.0 (control), 1.0, 1.5 and 2.0 g probiotic per kg diet. The basal diet contained 35% crude protein. Monosex Nile tilapia fry averaging 0.18 g in weight were stocked at a rate of 20 and 30 fish/$m^3$, within each density, 0.0, 1.0, 1.5 and 2.0g probiotic/kg diet were applied. Sixteen concrete ponds with 10 cm clayey loam each of 5x2.5x1.0 m were used to represent the two stocking density and the four doses of probiotic. The administration of feed was provided at a rate of 5% of live body weight of experimental fish, twice/day, 6 days a week, for 120 day. Each treatment was performed in duplicate. The obtained results revealed that diets supplemented with probiotic and maintain under low density showed significantly ($P<0.05$) better results of growth performance than those with the basal diet (control). Also, diet containing probiotic and fish group reared under low density resulted in significantly ($P<0.05$) a better productive performance as reflected in gain %, specific growth rate (SGR), relative growth rate (RGR) and feed conversion ratio (FCR), protein efficiency ratio (PER). The survival rate was enhanced due to the inclusion of probiotic in fish diets. On the other hand no significant differences ($P>0.05$) were observed in groups fed with probiotic supplemented diet and either under high density or low density. Moreover, using probiotic (Super biobuds) improved also the economical efficiency. Our results indicated that administration of probiotic (Super biobuds) in the diet promoted growth, enhanced survivability , decreased (improved) FCR and improved stress tolerance under high stocking density conditions suggesting its use will be beneficial for the aquaculture industry of monosex Nile tilapia fry during a single-stage nursery rearing system, that produce an adequate quantity of healthy fingerlings with lowest mortality at the beginning of the culture season for fish farmer.

**Key wards:** Nile tilapia, probiotic-super biobuds, stocking density, growth performance, feed utilization and survival rate.

## INTRODUCTION

Tilapia are the 3rd most important fish species for aquaculture all over the world, only after carp and salmonids (El-Sayed, 2004), and represents the major protein source in the developing countries especially Egypt, contributing 43.5% of farmed fish production and 24% of total fisheries production (GAFRD, 2007). Despite the great potential of tilapia culture, shortage of fry production to meet the increased global demands remain one of the main obstacles limiting the expansion of intensive cultured of these fishes. Information regarding fry culture, especially the effect of stocking density and commercial product of a probiotic know as super biobuds doses on fish fry management is limited, inconsistent and sometimes controversial. For example, Dambo and Rana (1992) found that the growth rates of Nile tilapia (*Oreochromis niloticus*) fry were negatively correlated with stocking density, ranging from 2 to 20 fry/litre water. They suggested 5 – 10 fry/liter as optimal stocking density. Similarly, El-sayed (2002) considered 5 fry/liter as optimal stocking density for *O. niloticus*. On the contrary, Gall and Bakar (1999) reported that body size of tilapia fry was not affected by stocking densities ranging from 10 to 200 fry/l, when water flow was uniform. Furthermore, El-Sayed (2002) confirmed that the relationship between the survival of Nile tilapia fry and stocking density was negatively correlated.

In aquaculture practices, probiotics are used for a quite long time but in last few years probiotics became an integral part of the culture practices for improving growth and disease resistance. This strategy offers innumerable advantages to overcome the limitations and side effects of antibiotics and other drugs and also leads to high production through enhanced growth and disease prevention. In aquaculture, the range of probiotics evaluated for use is considerably wider than in terrestrial agriculture (Lara-Flores *et al.,* 2003). Several probiotics either as monospecies or multispecies supplements are commercially available for aquaculture practices. Apart from the nutritional and other health benifits, certain probiotics as water additives can also play a significant role in decomposition of organic matter, reduction of nitrogen and phosphorus level as well as control of ammonia, nitrite, and hydrogen sulde. Moreover, water quality is improved by enhancing the mineralization process and reducing the accumulation of organic loads-improving feed conversion ratio when using probiotics. Bioremedition or bioaugmentations is a concept of reducing organic wastes to environmentally safe levels through use of micro or macroorganisms (Thomas *et al.,* 1992). The modes of probiotic action were as follows: production of inhibitory compounds; competition for chemicals or available energy; competition for adhesion sites; enhancement of the immune response; improvement of water quality; interaction with phytoplankton; source of macro and micronutrients; enzymatic contribution to digestion(Fukami *et al.,* 1997; Söderhäll and Cerenius, 1998 and Verschuere *et al.,* 2000). However, little had been done to incorporate probiotics into Nile tilapia (*Oreochromis niloticus*) based on growth performances at different densties and other traits. Thus this study was designed to evaluate the use of a probiotic as a natural growth promoter in diet for Nile tilapia (*Oreochromis niloticus*), reared in different densities. Thus and accordingly, this attempt has been done to investigate the effects of different stocking densities and different doses of a commercial probiotic on the growth performance, stress tolerance to high stocking density conditions, survival rate, feed efficiency and net returns of Nile tilapia (*O. niloticus L* ) reared in concrete ponds with earthen bottom (10 cm clayey loam soil pH 7.5) during a single-stage nursery-rearing system.

## MATERIALS AND METHODS

### Diet preparation and feeding regime

Four experimental diets were formulated (35% crude protein and 8% lipid) containing different levels of a probiotic (Super biobuds) being, 0.0 (control), 1.0, 1.5and 2.0 g/kg diet with different stocking densities low density (20 fish/ $m^3$) and high density (30 fish/ $m^3$). The proximate chemical composition of the diet was analyzed and is shown in Table1. In the present study, a probiotic was obtained from China Way Corboration Taiwan Co. The dry ingredients were thoroughly mixed and 150 ml of water was added per kg diet. Afterward, the mixture (ingredients and water) was blended using kitchen blender to make a paste of each diet. Pelleting of each diet was carried out by passing the blended mixture through laboratory pellet machine with a 3 mm diameter matrix. The pellets were dried in a drying oven model (Fisher oven 13-261-28A) for 24 hours at 65$^o$C and stored in plastic bags which were kept in a refrigerator at -2$^o$C during the experimental period to avoid rancidity. Experimental diet was formulated in Central Laboratory for Aquaculture Research (CLAR) to meet nutritional requirement of fish (NRC, 1993).

### Experimental design and fish culture technique

The present study was carried out at outdoor concrete ponds in Central Laboratory for Aquaculture Research, Abbassa, Abou-Hammad, Sharkia, Egypt. Sixteen concrete ponds each of (5x2.5 x1.0 m, 12.5$m^3$ volume each) were used in this study. The sixteen ponds represent two stocking densities (20 and 30 fry/$m^{3)}$ and within each stocking density studied four different doses of probiotic-super biobuds (0.0, 1.0, 1.5 and 2.0g/kg diet) were tested. Eight treatments were applied in the experimental concrete ponds. These were Control Low Density (CLD) stocked with 20fry/$m^3$ and fed the control diet (0.0g probiotic /kg diet), Control High Density (CHD) stocked with 30 fry/$m^3$ and also fed the basal diet, P1LD: stocked with 20 fry/$m^3$ and reaed with 1.0 g/kg diet, P1HD: stocked with 30 fry/$m^3$ and reared with 1.0g/kg diet, P2LD: stocked with 20 fry/$m^3$ and reared with 1.5g/kg diet, P2HD: stocked with 30 fry/$m^3$ and reared with 1.5g/kg diet, P3LD: stocked with 20fry/$m^3$ and reared with 2.0g/kg diet and P3HD:stocked with 30fry/$m^3$ and reared with 2.0g/kg diet. Each treatment was performed in duplicat. The ponds water quality was within the suitable range for fish growth and health, Table 2.

Before starting the experiment, all ponds were drained completely and then were exposed to sun rays for 2 weeks till complete dryness. The concrete ponds bottom was lined with 10 cm clayey loam farm soil (pH 7.5) before filling water. Ponds were then refilled with fresh water coming from Ismailia Nile branch through a canal to the experimental station. All-male Nile tilapia fry (hormonal treated), (0.18g average weight) were obtained from Arabia Co. for Fisheries and Hatchery, El-Abbassa, Abou-Hammad, Sharkia, Egypt. Fish in all treatments were fed throughout the 120 days study at a rate of 5% of live body weight twice daily at 9.00 and 13.00 hours, 6 days aweek. Fish in each pond were sampled biweekly and amounts of feed were adjusted according to body weight in samplings. At the end of the study, all fish were weighed and counted. Different parameters of fish growth were calculated.

**Chemical analysis of the experimental diet**

The tested diet was analyzed according to the standard methods of AOAC (1990) for moisture, protein, fat and ash. Moisture content was estimated by heating samples in an oven at 85$^{o}$C for 24 hours or until constant weight is reached before calculating weight loss. Nitrogen content was measured using a microkjeldahl apparatus and crude protein was estimated by multiplying nitrogen content by 6.25. Total lipids content was determined by ether extraction and ash was determined by combusting samples in a muffle furnace at 550$^oC$ for 6 hr. Crude fiber was estimated according to Goering and Van Soest (1970).

**Analysis of water physico-chemical parameters**

Water samples were biweekly collected from the concrete ponds for analysis. Dissolved oxygen and temperature were measure on site using a YSI oxygen meter (model Aqua Lytic OX24 USA). Unionized ammonia was measured using HACH Apparatus (HACH Co., Loveland, Colorado, USA), while pH was measured using a pH-meter (Orion 543). Electric conductivity (μmhos/cm) and dissolved solids (g/l) were measured by using salinity meter (YSI Co. model 300, USA). Total alkalinity and total hardness were measured by titration as described by Boyd (1990).

**Growth parameters**

Growth performance was determined and feed utilization was calculated as following:

Weight gain = W2 – W1; Where W1 and W2 are the initial and final fish weight, respectively; Daily weight gain = weight gain / T; where T is the interval time in days.

Specific growth rate (SGR) = 100 (Ln W2 – Ln W1) / T;

Relative growth rate (RGR) = 100 (W2-W1) / W1; Feed conversion ratio (FCR) = feed intake / weight gain and Protein efficiency ratio (PER) = weight gain (g) / protein ingested (g)

## Statistical analysis

The statistical analysis of data was carried out by applying the computer program, **SAS (2006)** by adopting the following model.

$$Yijk = \mu + Ri + \alpha j + Eijk$$

Where,yijk= the observation on the ijk$^{th}$ fish reared in the j$^{th}$ treatment for the i$^{th}$ replicate; μ=overall mean,Ri= the effect of i$^{th}$ replicate; αj=the effect of j$^{th}$ treatment and Eijk=random error.

Differences among means were tested for significance according to **Duncan's (1955).**

## RESULTS AND DISCUSSION

### Growth performance

The collected data for water quality during the study were summarized in Table 2. It is warth mentioning before discussing the results of Nile tilapia performance under the present experimental conditions that the water quality measurements were found to be within the normal range of tolerance and the well being of Nile tilapia fish during the rearing period.

At the begging of the trial, all fries were of the same age group with a mean weigh of 0.18g, Results of body weight as affected by different stocking densities (20 and 30 fry/m$^3$) and super biobuds as a natural growth promoter of probiotic doses (0 (control), 1.0, 1.5, and 2.0 g/kg diet) tested are described in Table 3. As presented in this Table, average body weight (BW) at all experimental periods (0-120 days) decreased as the fish stocking density increased from 20 to 30 fry/m$^3$ within each dose of the commercial probiotic tested, while the reverse was true with increasing the dose of probiotic from 1.0 to 2.0g/kg diet. These results are in complete agreement with those reported by Varela *et al.* (2010) who reported that specimens fed with commercial feed supplemented with probiotic (bacterium Pdp11) presented higher body weight evaluation throughout the experimental period compared with specimens fed with control feed. On the other hand, AL-Azab (2001) concluded that higher tilapia stocking densities released negative effects on body weight and length, where body weight and length decreased as the stocking density increased.

Results in Table 3, showed that average of specific growth rate (SGR) of mono sex Nile tilapia fry during the whole experimental period (0-120 days) were 3.4, 3.27, 3.53, 3.39, 3.78, 3.73, 3.93%/day and 3.9 for CLD, CHD, P1LD, P1HD, P2LD, P2HD, P3LD and P3HD, respectively, with significant ($P<0.05$) differences between groups of Nile tilapia reared with dietary administration of probiotic supplemented diet compared with groups of fish reared without probiotic supplemented diet (control). On the other hand, results in Table 3, showed that no significant ($P>0.05$) differences between groups of fish reared with dietary administration of super biobuds either submitted to high stocking density condition (30 fry/$m^3$) or maintained at low stocking density condition (20 fry/$m^3$). These results indicated, an improvement in SGR with groups fed with probiotic and under high stocking density and the improvement was more pronounced at higher dose of probiotic (2.0 g/kg diet). These findings may be attribute to the mitigation effect of probiotic to stress factor under high stocking density (HSD) that lead to increasing the stress tolerance of Nile tilapia fish to crowding social stresses and hence increases the growth. These results are in accordance with those reported by Varela *et al.* (2010) who studied the effects of dietary administration of probiotic (bacterium Pdp11) on growth and stress tolerance, indicated that administration of probiotic promotes growth and improves stress tolerance to HSD, suggesting that the use of this probiotic could be beneficial for the aquaculture industry.

In this respect, Saenz de Rodriganez *et al.* (2009) confirmed that the growth enhancement of *S. senegalensis* produced by probiotic could be due to an increase in enterocyte absorption by decreasing lipid inclusions or to the improvement in digestive enzymes activities. El-Sayed (2002) reported that SGR of Nile tilapia ( 0.016 g initial body weight) reared in fiberglass tanks , in a closed recirculating indoor system for 40 days, were negatively correlated with stocking density and this may be due to social stress causing chronic stress response. Also, Barcelos *et al.* (1999) reported that the resting plasma cortical concentration of Nile tilapia fingerlings increased with increasing density of fish, indicating a chronic stress response attributable to social stress. Furthermore, King *et al.* (2000) cleared that stress due to space availability was the primary factor inhibiting the growth of summer flounder *(Paralichthys dentatus* L.) larvae stocked at high densities.

As shown in Table 3, average SGR values of mono sex Nile tilapia were 3.9 and 3.27%/d for P3HD and CHD, respectively, with significant ($P<0.05$) differences between these values. These results indicate that fish reared with high administration dose of probiotic and submitted to higher densities (P3HD ) grow better than those reared without probiotic and also maintain at higher densities (CHD). These are in agreement with Wang and Xu (2006) who cleared that diets supplemented with probiotics showed significantly better results of growth performance and FCR than those with the basal diet (control). Also, the same trend was observed for the relative growth rate (RGR) and the averages of daily gain in weight (DWG) during the whole experimental period. Similar findings were reported by Varela *et al.* (2010) who noticed that growth in terms of length, weight gain and SGR of gilthead sea bream *Sparus auratus* reared in tanks in a flow through system were improved in group receiving probiotic compared to control group.

Results presented in Table 3 revealed significant ($P<0.05$) effects of dietary administration of probiotic and stocking density on fish survival and growth performance. Fish survival improved almost significantly ($P < 0.05$) with each increase in the dose of probiotic and decreasing the stocking density. The highest value of survival (96%) was obtained with P3LD while the lowest (81%) was observed for CHD. The results presented in Table 3 are in agreement with those reported by Moriarty (1998) and Rengpipat *et al.* (1998). These authors came to the conclusion that an increase of Nile tilapia survival in ponds was found where probiotics including some strains of Bacillus sp were introduced.

The relative increase in mortality at CHD and CLD where fish submitted at the highest density (30 fry/$m^3$) and fed the basal diet, without probiotic (CHD) and fish kept at the lowest density (20 fry/$m^3$) and fed also the basal diet (CLD, 19% and 17% mortality) ($P<0.05$), respectively was most likely due to the absence of probiotic supplemented diet. In contrast, the relative increase in survival rate (SR) at P3 LD and P3 HD where fish reared at the lowest density (20 fry/$m^3$) and fed the diet with the highest dose (2.0 g/kg diet) of probiotic (P3 LD) and fish reared at the highest density (30 fry/$m^3$) and fed the diet with the highest dose of probiotic(96.0 and 95.0% SR), respectively with insignificant ($P >0.05$) differences between these treatments. These findings may be attribute to the reduce of stress factors and hence increases the survival rate, due to the administration of probiotic at higher does (2.0 g/kg diet). These results are in accordance with those reported by Moriarty (1998) who found that an increase of prawn survival in ponds where probiotics including some strains of Bacillus sp. were introduced. Also, Rengpipat *et al.* (1998) came to the same conclusion that an increase of black tiger shrimp (*Penaeus monodon*) survival where treated by a probiotic bacterium.

In this connection, the results of Varela *et al.* (2010) are in agreement with the present findings. They reported that diets supplemented with probiotic can improve stress tolerance to high stocking density with respect to control diet in *S. auratus.*

Food utilization

Results in Table 4 show that average feed conversion ration (FCR) values during the whole experimental period (0-120 days) of fish reared at the higher dose of probiotic-supplemented diets either in high or low densities (P3HD or P3LD) were significantly ($P<0.05$) lower (improved) than those groups of fish fed the basal diet (control), without probiotic-suppplemented diets either in high or low densities (CHD or CLD). The better FCR values obtained with probiotic-supplemented diets suggested that the addition of the probiotic improved feed utilization of Nile tilapia by the improving in diet any nutrients including protein, starch and fat, which might in turn explain the better growth performance seen with the probiotic supplemented diets. Similar results had been reported for probiotic use in diets for Nile tilapia (*O. niloticus)* (Lara-Flores *et al.* 2003). Also, similar effects had been cleared for other fish in which digestibility was shown to increase considerably with the use of probiotic in the diet Lara-Flores *et al.* (2003); Tovar-Ramirez *et al.* (2004) and Wang and Xu (2006) cleared that probiotic highly increased the growth performances and digestive enzyme activities, and decreased (improved) FCR. In practical, this meant that the dietary administration of probiotic could decreases the amount of feed necessary for animal growth which could result in production cost reductions.suggesting that the addition of probiotic (supr biobuds) reduced the culture cost of Nile tilapia.

As illustrated in Table 4, the average FCR of groups of fish reared with the high administration dose of probiotic (2.0 g/kg diet ) was significantly lower (better) than those of fish fed the low administration dose of probiotic (1.0 g/kg diet) at both stocking densities (20 and 30 fry/m3). This indicates that the FCR improved with the increase in the administration dose of probiotic. On the other hand, results illustrated in Table 4 revealed no significant (P>0.05) differences between P3HD and P3LD in FCR. This indicates that, no significant effects of stocking density when the groups of fish reared with high administration dose of probiotic. Similar results were found by Lara-Flores *et al.* (2003) suggested that the propiotics could mitigate the effects of the stress factors.

Average of protein efficiency ratio (PER) of fish tended to increase at the high administration dose of probiotic at the two stocking densities tested (20 and 30 specimen/$m^3$), may be due to the stimulated protein-sparing action of propiotic for protein content in experimental diet. Also, there were insignificant (P>0.05) differences among the same dose of probiotic, except at CLD, CHD and P1LD, P1HD (0.0 and 1.0 g/kg diet) which showed significant (P<0.05) difference as shown in Table 4. This indicates that PER values were negatively correlated with stocking density when fish fed the basal diet (control ) or fish fed diet with low administration dose of probiotic (1.0 g/kg diet). Similar results were obtained by Abdel-Hakim *et al.* (2001) who reported that the average PER records of Nile tilapia (27.11-29.02 g initial body weight) stocked in fiberglass tanks at densities of 50 and 100 fish/$m^3$ decreased from 1.60 to 1.0 respectively.

**Economical efficiency**

The current investigation highlights the potential of using commercial product of a probiotic in diets as a growth promoter and to improve stress tolerance under high stocking density of male Nile tilapia reared in concrete ponds during the nursery-rearing period (120-days). Generally, results of the present study indicate that administration of the probiotic-super biobuds in the diet will be beneficial for the aquaculture industry of this species. Results in Table 5 show that the percentages of net returns relative to operating costs for different treatments were 6.79, 21.39, 32.08, 25.41, 17.95, 30.75, 26.73 and 41.47% for CLD, CHD, P1LD, P1HD, P2LD, P2HD, P3LD and P3HD, respectively. These results indicated that the highest benefits were obtained by fish of P3HD where fish reared with the highest dose of probiotic (2.0g/kg diet) and under high stocking density (30 fish/$m^3$) followed in a descending order by those of P1LD where fish reared with the lowest dose of probiotic (1.0g/kg diet) and maintain under low density (20fish/$m^3$) and P2HD where fish reared with the medium dose of probiotic(1.5g/kgdiet) and submitted under high density. The lowest net returns relative to total costs was recorded by fish of CLD, where fish reared without probiotic administrated diet(control) and maintain under low density.

Feeding costs in fish production is about 50% of the total production costs (Collins and Delmendo, 1979). All other costs in the present study are constant, therefore, the feeding costs required to produce one kg gain weight could be used to compare the different experimental treatments. The calculated figures showed that, although the total costs of food per meter was increased in all administration dose of probiotic in diet compared with control; yet an improvement in FCR was calculated in these treatments due to supplementation of probiotic in diet that will reduce the feed cost to produce one kg gain in weight by 9.35 and 14.94 % for P3LD and P3HD treatments, respectively, compared with the control either maintained under low density or submitted to high density. These results are in accordance with those of Lara-Flores *et al.* (2003), Tovar-Ramirez *et al.* (2004) and Wang and Xu (2006), they reported better FCR values observed with probiotic-supplemented diets suggested that addition of probiotics improved feed utilization of fish that leads to decrease the amount of feed necessary for animal growth which could result in reductions of production cost.

## Conclusion

Based on the obtained results it can be concluded that dietary administration of the probiotic-super biobuds in the fish diet (2.00 g/kg diet) promoted growth performance, improves FCR, enhances stress tolerance under high stocking density and increases net benefits, suggesting its use will be beneficial for the aquaculture industry of this species during the single-stage nursery-rearing period (120-days) for production of adequate quality seeds of mono- sex Nile tilapia in shorter time with lowest mortality in order to be available as healthy fry at the beginning of the culture season for fish farmers.

**Table (1):** Composition and proximate analysis of the experimental diets containing different doses of the probiotic Super biobuds.

| **Feed ingredients %** | **Control diet** | **Diet $_1$** | **Diet $_2$** | **Diet $_3$** |
|---|---|---|---|---|
| Fish meal | 17.21 | 17.21 | 17.21 | 17.21 |
| Soybean meal | 39.50 | 39.50 | 39.50 | 39.50 |
| Wheat bran | 28.94 | 27.94 | 27.44 | 26.94 |
| Ground corn | 5.00 | 5.00 | 5.00 | 5.00 |
| Corn oil | 2.24 | 2.24 | 2.24 | 2.24 |
| Cod oil | 2.05 | 2.05 | 2.05 | 2.05 |
| Vit. and Min. Premix[1] | 4.00 | 4.00 | 4.00 | 4.00 |
| Starch | 1.06 | 1.06 | 1.06 | 1.06 |
| Probiotic | 0.00 | 1.00 | 1.50 | 2.00 |
| Total | 100 | 100 | 100 | 100 |
| **Chemical analysis (% dry matter basis)** | | | | |
| Dry matter (DM) | 92.87 | 92.87 | 92.87 | 92.87 |
| Crude protein (CP) | 34.98 | 34.98 | 34.98 | 34.98 |
| Ether extract (EE) | 7.98 | 7.98 | 7.98 | 7.98 |
| Crude Fiber | 6.23 | 6.23 | 6.23 | 6.23 |
| Ash | 6.31 | 6.21 | 6.41 | 6.21 |
| NFE[2] | 44.50 | 44.60 | 44.40 | 44.60 |

[1] vitamin & mineral mixture/ kg premix : vitamin D3, 0.8 million IU; A, 4.8 million IU; E, 4g; K, 0.8g; BI, 0.4g; Riboflavin, 1.6g; B6, B12, 4mg; pantothenic acid, 4g; Nicotinic acid, 8g; Folic acid, 0.4g Biotin, 20 mg, Mn, 22g; Zn, 22g; Fe, 12g; Cu, 4g; I, 0.4g; Selenium, 0.4g and Co, 4.8 mg.

[2] -Nitrogen-Free Extract (calculated by difference) = 100 – (protein + lipid + ash + fiber) *according to Juncey(1982)*

**Table 2:** Effect of dietary administration of the probiotic super biobuds on water quality parameters in concrete ponds with 10 cm clayey loam earthen bottom stocked with Nile tilapia fry at different stocking densities.

| Parameters | Treatments | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | CLD | CHD | $P_1$LD | $P_1$HD | $P_2$LD | $P_2$HD | $P_3$LD | $P_3$HD |
| **Water temperature ($^{O}$C)** | 26.5 ±0.35 | 26.31 ±0.41 | 25.81 ±0.43 | 26.53 ±0.51 | 26.25 ±0.35 | 26.83 ±0.53 | 25.91 ±0.51 | 26.21 ±0.45 |
| **Dissolved oxygen (mg/l)** | 6.7 ± 0.2 | 7.43 ±0.35 | 7.51 ±0.33 | 6.8 ± 0.45 | 7.21 ±0.37 | 7.51 ±0.35 | 7.33 ±0.45 | 6.93 ±0.43 |
| **PH** | 9.33 ±0.13 | 9.21 ±0.1 | 9.11 ±0.09 | 9.15 ±0.11 | 9.2± 0.13 | 9.25 ±0.1 | 9.35 ±0.13 | 9.13 ±0.1 |
| **NH3 (mg/l)** | 0.32 ±0.13 | 0.35 ±0.13 | 0.30 ±0.13 | 0.31 ±0.13 | 0.25 ±0.13 | 0.27 ±0.13 | 0.23 ±0.13 | 0.23 ±0.13 |
| **Total alkalinity (mg/L)** | 231.0 ±25.1 | 223.0 ±26.9 | 210.0 ±21.9 | 208.0 ±27.01 | 219.5 ±30.5 | 221.3 ±31 | 229.1 ±29 | 223.4 ±27.5 |
| **Total hardness (mg/L)** | 110.5 ±6.31 | 114.3 ±5.51 | 111.9 ±6.13 | 108.3 ±5.91 | 115.4 ±6.31 | 113.31 ±5.81 | 118.0 ±6.31 | 110.5 ±5.75 |
| **E.C. (µmhos/cm)** | 605.5 ±55.5 | 569.3 ±61.5 | 519.3 ±63.4 | 609.3 ±61.5 | 585.5 ±63 | 610.0 ±60.5 | 583.5 ±61.3 | 610.0 ±59.5 |
| **Total dissolved solid (g/l)** | 0.431± 0.051 | 0.351± 0.035 | 0.341± 0.043 | 0.321± 0.033 | 0.341± 0.035 | 0.431± 0.036 | 0.361± 0.031 | 0.351± 0.036 |

**Table 3:** Growth performance (mean ± SE) of Nile tilapia fry reared in concrete ponds with 10 cm clayey loam earthen bottom as affected by different stocking densities and dietary administration of probiotic super biobuds during the rearing period (120 day).

| Parameters | Treatments | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | CLD | CHD | $P_1$LD | $P_1$HD | $P_2$LD | $P_2$HD | $P_3$LD | $P_3$HD |
| **Initial body weight (g)** | 0.18[a] ±0.001 | 0.18[a] ±0.001 | 0.18[a] ±0.001 | 0.18[a] ±0.001 | 0.18[a] ±0.001 | 0.18[a] ±0.001 | 0.18[a] ±0.001 | 0.18[a] ±0.001 |
| **Final weight (g)** | 6.41[d] ±0.38 | 5.6[e] ± 0.39 | 7.31[c] ± 0.39 | 6.3[d] ± 0.31 | 9.51[ab] ±0.39 | 9.01[b] ±0.38 | 11.13[a] ±0.38 | 10.81[a] ±0.35 |
| **Daily weight gain (g/day/fish)** | 0.059[b] ±0.003 | 0.052[c] ±0.003 | .068[ab] ±0.001 | 0.058[b] ±0.001 | 0.089[a] ±.003 | 0.084[ab] ±0.002 | 0.100[a] ±0.002 | 0.100[a] ±0.002 |
| **Net increment** | 6.23[cd] ±0.11 | 5.42[d] ± 0.11 | 7.13[c] ± 0.11 | 6.12[cd] ±0.11 | 9.32[b] ±0.15 | 8.83[bc] ±0.11 | 10.95[a] ±0.21 | 10.63[a] ±0.21 |
| **SGR (%/d)** | 3.40[b] ±0.15 | 3.27[c] ± 0.15 | 3.53[b] ±0.11 | 3.39[b] ± 0.11 | 3.78[a] ± 0.13 | 3.73[ab] ±0.11 | 3.93[a] ±0.13 | 3.90[a] ± 0.11 |
| **RGR (%)** | 34.61[c] d±0.13 | 30.11[d] ±0.13 | 39.61[c] ±0.15 | 34.00[c] d±0.15 | 51.78[b] ±0.17 | 49.11[a] [b]±0.15 | 60.83[a] ±0.15 | 59.11[a] ±0.14 |
| **Survival rate (%)** | 83.0[c] ±0.11 | 81.0[d] ±0.11 | 87.0[bc] ±0.11 | 84.0[c] ±0.11 | 92.0[ab] ±0.11 | 90.0[b] ±0.11 | 96.0[a] ± 0.11 | 95.0[a] ± 0.11 |

Means followed by different letters in the same row for each trait are significantly different (P<0.05).

**Table 4:** Effects of different doses of probiotic and stocking density on feed utilization of monosex Nile tilapia fry reared in concrete ponds during the nursery period (120 day) .

| Parameters | Treatments | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | CLD | CHD | $P_1$LD | $P_1$HD | $P_2$LD | $P_2$HD | $P_3$LD | $P_3$HD |
| **Feed intake ( g/fish)** | 13.32[d] ± 0.13 | 12.42[e] ±0.15 | 15.42[c] ±0.11 | 12.72[e] ± 0.16 | 19.02[ab] ± 0.14 | 18.27[b] ± 0.15 | 21.27[a] ± 0.15 | 20.7[a] ± 0.15 |
| **Protein intake (g/fish** | 4.02[c] ± 0.09 | 3.74[c] ±0.09 | 4.65[b] ±0.081 | 3.84[c] ± 0.083 | 5.73[ab] ±0.083 | 5.51[ab] ± 0.081 | 6.41[a] ±0.081 | 6.24[a] ±0.083 |
| **FCR** | 2.14[ab] ± 0.03 | 2.29[a] ±0.03 | 2.16[ab] ± 0.03 | 2.08[b] ± 0.03 | 2.04[b] ± 0.03 | 2.07[b] ± 0.03 | 1.94[c] ± 0.03 | 1.95[c] ± 0.03 |
| **PER** | 1.55[c] ±0.05 | 1.45[e] ± 0.05 | 1.53[c] ±0.05 | 1.59[b] ± 0.05 | 1.63[b] ±0.05 | 1.60[b] ± 0.05 | 1.71[a] ± 0.05 | 1.70[a] ± 0.05 |

Means followed by different letters in the same row for each trait are significantly different (P<0.05).

**Table 5:** Economical evaluation of the experimental treatments.

| Parameters | Treatments | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | CLD | CHD | $P_1$LD | $P_1$HD | $P_2$LD | $P_2$HD | $P_3$LD | $P_3$HD |
| Stocking rate (No./m3) | 20 | 30 | 20 | 30 | 20 | 30 | 20 | 30 |
| Probiotic, g/kg diet | 0.0 | 0.0 | 1.0 | 1.0 | 1.5 | 1.5 | 2.0 | 2.0 |
| Average size at stocking (g) | 0.18 | 0.18 | 0.18 | 0.18 | 0.18 | 0.18 | 0.18 | 0.18 |
| Average size at harvest (g) | 6.41 | 5.6 | 7.31 | 6.3 | 9.51 | 9.01 | 11.13 | 10.81 |
| Total weight gain (g/fish) | 6.23 | 5.42 | 7.13 | 6.12 | 9.33 | 8.83 | 10.95 | 10.63 |
| Survival rate (%) | 83.o | 81.0 | 87.o | 84.o | 92.o | 90.o | 96.o | 95.o |
| Total no. at harvest / $m^3$ | 16.6 | 24.3 | 17.4 | 25.2 | 18.4 | 27.0 | 19.2 | 28.5 |
| A-Operating costs | | | | | | | | |
| Fish fry 50 L.E/1000 fry | 1.0 | 1.5 | 1.0 | 1.5 | 1.0 | 1.5 | 1.0 | 1.5 |
| Cost of one ton feed (L.E) | 2950 | 2950 | 2950 | 2950 | 2950 | 2950 | 2950 | 2950 |
| Cost of probiotic/ ton feed (L.E.) | ------- | ------- | 60 | 60 | 90 | 90 | 120 | 120 |
| Relative to control (%) | 0.0 | 0.0 | 60 | 60 | 90 | 90 | 120 | 120 |
| Increase in feed cost (L.E./ton%) | | 0.0 | 60 | 60 | 90 | 90 | 120 | 120 |
| Feed intake (g feed / fish | 13.32 | 12.42 | 15.42 | 12.72 | 19.02 | 18.27 | 21.27 | 20.7 |
| Total feed (kg/$m^3$) | 0.27 | 0.37 | 0.31 | 0.38 | 0.38 | 0.55 | 0.43 | 0.6 |
| Probiotic(g/$m^3$) | ------- | ------- | 0.31 | 0.38 | 0.38 | 0.55 | 0.43 | 0.6 |
| Cost of feed /$m^3$ (L.E.) | 0.8 | 1.1 | 0.91 | 1.1 | 1.1 | 1.6 | 1.3 | 1.8 |
| Cost of probiotic/$m^3$ | ------- | ------- | 0.019 | 0.023 | 0.023 | 0.033 | 0.026 | 0.036 |
| Labour, equipment and texas/$m^3$ | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Total costs/$m^3$ (L.E.) | 2.8 | 3.6 | 2.93 | 3.62 | 3.12 | 4.13 | 3.33 | 4.34 |
| Feed conversion ratio (FCR) | 2.14 | 2.29 | 2.16 | 2.08 | 2.04 | 2.07 | 1.94 | 1.95 |
| Feed cost to produce 1 kg fish (L.E.) | 6.31 | 6.76 | 6.37 | 6.14 | 6.02 | 6.11 | 5.72 | 5.75 |
| Relative to control (%) | 100 | 100 | 100.95 | 90.83 | 95.4 | 90.38 | 90.65 | 85.06 |
| B- total returns | 2.99 | 4.37 | 3.13 | 4.54 | 3.68 | 5.4 | 4.22 | 6.27 |
| Net returns (L.E./$m^3$) | 0.19 | 0.77 | 0.94 | 0.92 | 0.56 | 1.27 | 0.89 | 1.93 |
| Net returns to operating cost (L.E./$m^3$) | 6.79 | 21.39 | 32.08 | 25.41 | 17.95 | 30.75 | 26.73 | 44.47 |

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# تأثير استخدام مستويات مختلفة من المنتج التجارى للبروبيوتك وكثافة التخزين على أداء النمو والحيوية وكفاءة الاستفادة من الغذاء لأسماك البلطى النيلى وحيد الجنس خلال فترة الرعاية

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## الملخـــص العربـــى

اجريت هذه الدراسة لبحث تأثير مستويات مختلفة من البروبيوتك (Super biobuds) فى العليقة كمنشط نمو طبيعى وكذلك كثافة التخزين على أداء النمو ، معدل الاعاشة ، الاستفادة من الغذاء والكفاءة الاقتصادية( الربح ) لأسماك البلطى النيلى وحيد الجنس خلال فترة الرعاية .تم تكوين أربعة علائق تجريبية لتحتوى صفر (عليقة ضابطة)، 1، 1,5و 2,00جم بربيوتك/كجم عليقة 35%)بروتين تم تسكين زريعة البلطى النيلى وحيد الجنس بمتوسط وزن 0,18جم وبمعدل 20، 30سمكة/م$^3$فى ستة عشر حوض خرساني ذات قاع 10سم تربة بأبعاد 1,0x 5x2.5م . تم تغذية الأسماك بمعدل 5%من وزن الجسم مرتين فى اليوم ، 6أيام فى الاسبوع ولمدة 120يوما .مثلت كل معاملة فى مكررين .

وتشير النتائج المتحصل عليها الى :

تحسن أداء النمو تحسنا معنويا ($P<0.05$) وذلك باستخدام العلائق المحتوية على البروبيوتك تحت تأثير الكثافة المنخفضة وذلك بالمقارنة بالعليقة الضابطة ( صفر بروبيوتك / كجم عليقة ) أيضا حققت العلائق المحتوية على البروبيوتك تحت تأثير الكثافة المنخفضة (20 سمكة /م $^3$) تحسنا معنويا ($P<0.05$) النسبة لصفات الكفاءة الانتاجية مثل %للعائد ، معدل النمو النوعى ، كفاءة التحويل الغذائى، كفاءة تحويل البروتين .تحسن معدل الاعاشة نتيجة استخدام البروبيوتك فى علائق الاسما ك.

ومن جهه أخرى لوحظ عدم وجود فروق معنوية ($P> 0.05$) فى المجموعات التى تغذت على عليقة تحتوى على البربيوتك سواء أكانت تحت الكثافة المرتفعة أو المنخفضة . بالإضافة إلى ذلك لوحظ أن استخدام البربيوتك (Super biobuds) أدى الى تحسن فى الكفاءة الاقتصادية.

دلت النتائج إلى أن إضافة البروبيوتك إلى العلائق بمستوى ٢ جم لكل كجم عليقة أدى الى تنشيط النمو ، تحسن الحيوية ومعدل التحويل الغذائى كذلك تحسنت قوة التحمل للأسماك تحت تأثير ظروف الكثافة العالية، وهذا يدل على أن استخدام البروبيوتك يكون مفيد ونافع فى صناعة الثروة السمكية وخاصة لسمكة البلطى النيلى خلال فترة الرعاية وذلك لإنتاج نوعية جيدة من أصبعيات أسماك البلطى النيلى وحيد الجنس بالعدد الكافى وبأقل معدل وفيات وحتى تصبح متوافرة وأكثر حيوية للمزارعين فى بداية موسم الاستزراع.