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EVALUATION OF TWO COMMERCIAL FEED (FLOATING AND SINKING) FOR NILE TILAPIA FINGERLINGS (*Oreochromis niloticus*) REARED IN EARTHEN PONDS

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Abstract

This experiment aimed to study the effect of floating and sinking feed on the productive performance of *Oreochromis niloticus* fingerlings in earthen ponds under Egyptian conditions; during season 2016 (from May to November; about 26 weeks). Six earthen ponds (4200 m^2/ in each pond) were used in this study. *O. niloticus* fish were exposed to treatments; (Two replicates for each treatment). The first treatment fish were fed on two diets; crude protein and in the third treatment fish were fed on artificial feed 30% crude protein (factorial design). *O. niloticus* fingerlings average weight about 12.46 ± 1.27g was assigned randomly (12000 fingerlings/fed). Results show that, the fish feeding floating diet recorded the highest ranges of body weight, body length, condition factor, daily weight gain and specific growth rate. Also, the diet contains 30% crude protein recorded the highest ranges of body weight, body length, condition factor, daily weight gain and specific growth rate. Based on results obtained in this study and on the economical evaluation, it could be concluded that feeding floating pellets were better than feeding sinking other types of pellets, in addition to the increasing of protein percentage in diet was best in terms of economic efficiency compared with other treatments.

Key words: Earthen ponds, floating and sinking, protein level, *O. niloticus*

INTRODUCTION

Aquaculture in Egypt witnessed a significant and rapid expansion over the last few years. While semi intensive fish culture in earthen ponds is the most important farming system in Egypt, recent years have witnessed a rapid development of intensive systems in both tanks and cages in addition to farming in the desert. As a result, farmed fish production increased from only 63,895 tons in 1992, representing 18.5% of total Egyptian fish production to reach 1,017,738 tons in 2012, contributing 74% total production GAFRD, 2014).

Meanwhile the farmed area has increased from about 42,000 ha in 1999 (El-Sayed, 1999) to 120, 000 ha in 2012 (GAFRD, 2014). Tilapias are now the second most popularly formed fish after carps, and currently tilapia are culture in about 100 countries in order tropical and subtropical regions.

Feed comprises about one half of the variable cost associated with fish production. Understandably, producers are interested in knowing how much feed the fish are consuming. In addition to extra expense, water quality can deteriorate unnecessarily due to the addition of excess feed. Extruded, floating feeds offer the advantage of watching the feeding response as opposed to a sinking, steam -pelleted feed. Extruded feeds cost more to manufacture than steam-pelleted feeds due to the extra energy required and nutrients lost during the extrusion process. Extrusion involves the plasticizing and cooking of feed ingredients by a combination of pressure, heat and friction. Steam pelleting uses heat, moisture and pressure to create larger feed particles (Azzaydi *et al*., 2000). During the last decade, there has been a marked increase in the use of extruded foods for feeding fish. These foods have superior water stability, better floating properties and a higher energy than pelleted foods (Hilton *et al.*, 1981; Jonsen and Wanndsvik, 1991 and Ammar, 2008 a,b). The main effects on fish are an increase in fish growth and an improvement in feed conversion ratio (Roberrtt *et. al*., 1993).

El-Sayed *et al.* (2015) cited that about 90% of Egyptian aqua foods are produced by the private sector in the form of conventionally pressed, pelleted feeds (80–85%) and extruded feeds (15–20%). Extruded (expanded, or floating) aquafeed technology was introduced into Egypt in the mid-1990s. Since 2001, a number of commercial, private feed manufacturers have added production lines for extruded feed production to complement their traditional production lines. The market demand for extruded feed is increasing, despite the significantly higher prices. Tilapia farmers prefer this type of feed because it is better digested, converted and assimilated by the fish (El-Sayed, 2007). Indeed, approximately 40 percent of surveyed tilapia farmers use extruded feeds. Currently there are 5 mills producing extruded fish feed; representing 20–25% of total fish feed production. Feed mills also provide a wide range of different feed formulations to match the requirements of different stages of the growth cycle (e.g. different protein content). In addition to the registered mills, there are around 50 small-scale pelletizing units, each producing 3000–4000 ton/year and with total annual production of 120,000 to 240,000 ton (El-Naggar *et al.,* 2011). These pelletizing units use simple technology and may not be equipped with air driers. They offer the service of compressing farmers' feed ingredients for about EGP 100–150/ton (El-Naggar *et al.,* 2011).

The present study was conducted to comparison between affected of two types from commercial ration (floating and sinking) feed on growth performance of Nile tilapia in earthen ponds.

MATERIAL AND METHODS

The study had been done in a private farm (in Tollumbat No. 7 in Riyad City, Kafr El-Sheikh governorate, Delta district at the Northern part of Egypt) to evaluate the effect of floating and sinking feed on the productive performance of *Oreochromis niloticus* fingerlings in earthen ponds under Egyptian conditions. The pond preparation, stocking density and pond daily management are described in details. Also, water quality measurements, fish sampling and data collected during harvest are recorded too. Equations and statistical methods for analysing the specific growth rate, daily weight gain and the condition factor are given.

The current experiment was conducted using randomized block design for three treatments of similar surface area (4200 m^2) in each pond. The experimental ponds were equal in water volume (6300 m^3) with the same average water depth of 150 cm. before beginning of this experiment. The farm water source was mainly agricultural drainage water and comes from El-Gharbia drainage canal. The water system of the experimental ponds is maintained by gravity.

Experimental fish:

Fish species:

The experimental ponds were stocked with *O. niloticus* fingerlings (12,000 of fingerlings/ feddan). The fingerlings were stocked with an average initial total length were 8.78 cm for Floating tratments and 8.56 cm for Sinking tratments and an average initial total weight of 12.46 ± 0.17 g for all treatments.

Feed quantity was adjusted according to average body weight of the sample in each pond. In order to determine the average weight of fish, biweekly samples were taken by seining where 100 fishes from each pond (replicate) were collected and then released again in the pond after individual measuring the weight and length.

O. niloticus fish were exposed to six treatments for comparison between effected of two types from commercial ration (floating and sinking) feed on growth performance of Nile tilapia in earthen ponds under different levels of protein 20, 25 and 30% protein (6 treatments with 2 replicates- twelve earthen ponds 1 feddan each). and fed six days per week at a daily feeding rate of 3% of the estimated fish-weight twice at 9.00 am and 3.00 pm during the experimental period. Feed was applied by broadcasting over pond water surface in the same place and fish were considered satiated when they did not show an interest on the feed.

Water quality:

Water samples were taken biweekly for determination of dissolved oxygen, PH, and salinity. Average water quality parameters are illustrated in Table (2). Analysis methods were done according to the American public health Association (APHA, 1992). The PH values were determined by digital pH meter (Orient Research Model 201), the water temperature, seccki disk reading (transparency) and oxygen saturation were measured daily at 9.00 by an oxygen meter (model 9070).

Water Quality parameters:

Results of water quality parameters of the experimental ponds during the experimental period as averages of the monthly samples are summarized in Table (1).

Table 1. Water quality parameters of earthen ponds during to experimental period

Parameters	Floating diet			Sinking diet		
	T1(20% protein)	T2(25% protein)	T3(30% protein)	T1(20% protein)	T2(25% protein)	T3(30% protein)
Tem. (C°)	26.2±1.2	26.8±1. 4	25.9±1. 1	25.5±1. 1	26.4±1. 3	26.1±1. 3
DO oxygen	5.9±0.3	6.4±0.4	5.9±0.3	5.7±0.3	6.8±0.2	6.1±0.3
PH	7.7±0.6	8.1±0.7	8.0±0.7	7.4±0.7	7.9±0.8	7.3±0.5
S. disk (cm)	23.2±1.5	24.11.2	23.1±1.4	21.4±1.1	20.9±1.2	21.6±1.4
Salinity (ppm)	0.68±0.6	0.68±0.6	0.70±0.7	0.66±0.6	0.68±0.7	0.68±0.5

AIT (1986) and Hasssan *et al.* (1997) found that 2.3 mg DO/l is above the normal tolerance level of Nile tilapia tilapia. Boyd (1998) cited that water with a pH ranges of 6.5 – 9 are the most sui Table for fish culture. Also, he reported that, the decreasing in seechi disk reading less than 20 cm indicates that pond is too turbid, which may due to either phytoplankton or suspended soil particles. Salinity ranged between 0.66 – 0.68. Abd El-hameid *et al.* (2002 a, b) suggested that these values are suiTable for rearing Nile tilapia.

Fertilizers applications:

The experiment was carried out during season 2016 (from May to November). Ponds were fertilized for 26 weeks. Fertilization was done once biweekly by broadcasting of:

Organic fertilizer: poultry manure 50 kg (treated by heating in commercial food factory) /fed/biweekly: during the experimental period and the application was done on pond surface.

Inorganic fertilizers: (Triple super phosphate; 20% P_2O_5 and urea containing 46% nitrogen) were added as sources of phosphorus and nitrogen to ponds biweekly at a rate of 10 kg/fed, of Triple super-phosphate, by dissolving it in water and splashed all over the experimental ponds water. While 5 kg urea/fed, were broadcasted at pond water surface.

Growth and feed utilization parameters:

Average weight gain (AWG), average daily gain (ADG), specific growth rate (SGR % d), feed/gain ratio, feed conversion ratio (FCR), protein efficiency ratio (PER) and survival rate were calculated according to the following equations:

a) Average weight gain (g/fish) (AWG): WG = W2 – W1

Where: W1 = The initial weight (g)

W2 = The final weight (g)

b) Average daily weight gain (ADWG)

$$ADG = \frac{W2 - W1}{T}$$

Where: T = Experimental period (d)

c) Specific growth rate (SGR)

$$SGR = \frac{Ln.\ W2 - Ln.\ W1}{Period\,(days)} \times 100$$

Where: Ln = Natural Logarithm (log)-10

W1 = Mean initial weight (g)

W2 = Mean final weight (g)

Feed/gain ratio, feed conversion ratio (FCR), protein efficiency ratio (PER) and survival rate

Harvesting:

At the end of this experiment (after 26 weeks) ponds were gradually drained from the water and fish were harvested by seining and transferred to fiberglass tanks and carried to the processing center where they washed, and the fish were sorted and collectively weighed.

Proximate analysis:

Proximate analysis for silage, experiment diets, plant leaves tested and whole fish bodies were carried out for moisture, ash, protein and fat % according to the methods described by A.O.A.C. (1990). Nitrogen free extract (NFE) was calculated by differences.

Statistical analysis:

The statistical analysis of data collected was carried out by applying the computer program (SAS, 1996). Differences among means were tested for significancy according to Duncan's multiple range tests (Duncan, 1955).

RESULTS AND DISCUSSION

Body weight and length:

Table (2) shows means of body weight and length, at the start and the end of the experiment as affected by feed type (floating and sinking pellets). As described in this table, the averages of initial weights of *O. niloticus* were 12.46 and 12.17g respectively; while at the end of the experiment, the averages of body weight for *O. niloticus* were 281.63 and 267.30g, respectively regardless protein levels. As described in this table, the averages of initial length of *O. niloticus* were 8.87 and 8.56 cm, respectively; while at the end of the experiment, the averages of body length for *O. niloticus* were 28.47 and 27.96 cm for the two types, respectively.

These results indicate that, the body weight and length for floating feed was higher than that obtained in sinking feed. And the differences between two feeds were significant ($P<0.05$)

Improved growth of fish fed extruded floating diet may be due to the presence of pelleted floating diet above the water surface, which can fish taken and benefit from it as well as the fish movement and activity as a result of rise of the water surface to feed, which works to improve digestion. But the extruded sinking diet on the feeder lose part of them as a result of movement of fish and download to the bottom of pond and mixed with mud and fish not benefit them as well as change the water properties as a result of the accumulation of feed waste analyzed in water causing increased total ammonia concentration in ponds.

Abou-Zied (2015) when studied effect of diet extruded type on growth performance, feed utilization and economic efficiency of nile tilapia in commercial farms found that, final mean weight and weight gain were significantly ($P \leq 0.05$) better with extruded floating diet, while lower values were recorded with extruded sinking diet. While, Samwel (2015) found that, the results on growth parameters showed that, floating and sinking diets had no significant effect on main final weight

With regard to the effect of protein level (L) on body weight and length, Table (2) showes that, the initial body weight was 12.30, 12.35 and 12.30g for three levels of protein, 20, 25 and 30%, respectively. While at the end of experiment the means of body weight for treatments were 259.13, 274.33 and 289.93g for three levels, respectively. While, the initial body length were 8.70, 8.74 8.82 cm for three levels of protein, 20, 25 and 30%, respectively. While at the end of experiment the means of body length for treatments were 28.05, 28.40, 29.20 cm for three levels, respectively regardless of type food.

These results indicate that, the average body weight for the third level (30% protein) was higher than other levels. The analysis of variance of these results indicates that, the differences among different levels were significant ($P<0.05$). These results are in agreement with Abdoulaye (2013) when studied effects of dietary protein level on growth performance, carcass composition and survival rate of fry monosex Nile tilapia, *Oreochromis niloticus* reared under re-circulating system. He found that, weight gain of fish was improved significantly with increasing dietary protein levels from 21 to 37%. However, there was no significant increase in fish fed on diet containing 21, 25 and 45% protein. The best results were obtained with a dietary protein level of 32 and 37% in respect of weight gain

Table 2. Least-square means and tested standard error of the factors affecting on body weight (gm) and body length (cm).

Item	No. of fish	Initial weight	Final weight	Initial length	Final length
Feed type (F)					
F1 (Floating)	**600**	12.46±0.72^{a}	281.63±2.34^{a}	8.87±0.73^{b}	28.47±1.27^{a}
F2 (Sinking)	**600**	12.17±0.72^{a}	267.30±2.34^{b}	8.56±0.73^{a}	27.96±1.27^{b}
Protein level (P)					
L1 (20% protein)	**400**	12.30±0.89^{a}	259.13±2.67^{c}	8.70±0.90^{a}	28.05±1.09^{c}
L2 (25% protein)	**400**	12.35±0.89^{a}	274.33±2.67^{b}	8.74±0.90^{a}	28.40±1.09^{a}
L3 (30% protein)	**400**	12.30±0.89^{a}	289.93±2.67^{a}	8.82±0.90^{a}	29.20±1.09^{b}
Interaction between F (type of feed)*P (type of protein level)					
F1* L1	**200**	12.30±1.27^{a}	266.12±2.78^{d}	8.70±0.93^{b}	28.40±1.07^{b}
F1* L2	**200**	12.50±1.27^{a}	281.33±2.78^{b}	8.90±0.93^{b}	28.50±1.07^{d}
F1* L3	**200**	12.60±1.27^{a}	297.43±2.78^{a}	9.00±0.93^{b}	29.50±1.07^{a}
F2* L1	**200**	12.30±1.27^{a}	252.14±2.78^{d}	8.70±0.93^{a}	27.70±1.07^{e}
F2* L2	**200**	12.20±1.27^{a}	267.31±2.78^{c}	8.80±0.93^{a}	28.10±1.07^{c}
F2* L3	**200**	12.00±1.27^{a}	282.44±2.78^{b}	8.70±0.93^{a}	28.90±1.07^{b}

$^{a, b, c, d}$ Means of the same row with different superscripts are significantly.
Means with the same letter in each column are not significantly different (P≥0.05).

Results presented in Table (2) show that variations were significant (P<0.05) due to the interaction between food type (floating and sinking pellets) and protein levels (20, 25 and 30% protein) (F*L) which indicated that these two factors act dependently on each other and also each of them had its own significant effect. The averages of initial weights of *O. niloticus* were 12.30, 12.50, 12.6, 12.30, 12.20 and 12.00g; while at the end of the experiment, the averages of body weight were 266.12, 281.33, 297.43, 252.14, 267.31, and 282.44g, respectively for the treatmentsF1* L1, F1* L2, F1* L3, F2* L1, F2* L2 and F2* L3. The averages of initial length of *O. niloticus* were 8.70, 8.90, 9.00, 8.70, 8.8 and 8.7 cm; while at the end of the experiment, the averages of body length were 28.4, 28.50, 29.50, 27.70, 28.1 and 28.90 cm, respectively for the treatments F1* L1, F1* L2, F1* L3, F2* L1, F2* L2 and F2* L3. As showed in this Table, the best final weight and length was obtained for 3rd treatment (floating pellets, being 297.43g and 29.50 cm) at protein level 30%.

Condition factor (K):

Table (3) shows means of Condition factor (K), at the start and the end of the experiment as affected by food type (floating and sinking pellets). As described in this table, the averages of initial (K) of *O. niloticus* were 1.79 and 1.83, respectively; while at the end of the experiment, the averages of (K) for *O. niloticus* were 1.22 and 1.27, respectively regardless protein levels.

These results indicate that, the condition factor K was decreased with extruded floating diet. It is advantageous to feed a floating (extruded) food, because the farmer can directly observe the feeding intensity of his fish. The use of floating diets saves about 25% of the food that would otherwise be lost in the potom of pond if sinking diets used (El-Sayed, 2013).

Table 3. Least-square means and standard error of the tested factors affecting on condition factor (K) and ADWG and SGR.

Item	No.	Initial K	Final K	ADWG/fish	SGR, %/day
Food type (F)					
F1	600	$1.79{\pm}0.31^{a}$	$1.22{\pm}0.15^{a}$	$1.48{\pm}0.27^{a}$	$1.71{\pm}0.33^{a}$
F2	600	$1.83{\pm}0.31^{a}$	$1.27{\pm}0.15^{a}$	$1.40{\pm}0.27^{b}$	$1.70\ {\pm}0.33^{a}$
Protein level (P)					
L1	400	$1.87{\pm}0.39^{a}$	1.17±0.11b	$1.36{\pm}0.29^{b}$	$1.68{\pm}0.32^{a}$
L2	400	1.78±0.39a	$1.33{\pm}0.11^{a}$	$1.44{\pm}0.29^{a}$	$1.70{\pm}0.32^{a}$
L3	400	$1.77{\pm}0.39^{a}$	$1.23{\pm}0.11^{b}$	$1.53{\pm}0.29^{a}$	$1.74{\pm}0.32^{a}$
Interaction between D*P					
F1* L1	200	$1.87{\pm}0.55^{a}$	$1.16{\pm}0.09^{b}$	$1.39{\pm}0.24^{b}$	$1.69{\pm}0.29^{a}$
F1* L2	200	$1.77{\pm}0.55^{a}$	$1.35{\pm}0.09^{a}$	$1.48{\pm}0.24^{ab}$	$1.71{\pm}0.29^{a}$
F1* L3	200	$1.73{\pm}0.55^{a}$	$1.16{\pm}0.09^{b}$	$1.57{\pm}0.24^{a}$	$1.74{\pm}0.29^{a}$
F2* L1	200	$1.86{\pm}0.55^{a}$	$1.19{\pm}0.09^{b}$	$1.32{\pm}0.24^{c}$	$1.66{\pm}0.29^{b}$
F2* L2	200	$1.79{\pm}0.55^{a}$	$1.31{\pm}0.09^{a}$	$1.40{\pm}0.24^{b}$	$1.70{\pm}0.29^{a}$
F2* L3	200	$1.82{\pm}0.55^{a}$	$1.30{\pm}0.09^{a}$	$1.49{\pm}0.24^{ab}$	$1.73{\pm}0.29^{a}$

[a, b, c, d] Means of the same row with different superscripts are significantly.
Means with the same letter in each column are not significantly different ($P{\geq}0.05$).

With regard to the effect of protein level (L) on (K), Table (3) showes that, the initial K were 1.87, 1.78 and 1.77 for three levels of protein, 20, 25 and

30%, respectively. While at the end of experiment the means of (K) for treatments were 11.17, K that, the average Condition factor for the third level (30% protein) was higher ($P<0.05$) than other levels. The analysis of variance of these results indicates that, the differences among different levels were significant ($P<0.05$). These results are in agreement with Abdoulaye (2013). He found that, K of fish was improved significantly with increasing dietary protein levels from 21% to 37%.

Results presented in Table (2) show that variations were significant ($P<0.05$) due to the interaction between food type (floating and sinking pellets) and protein levels (20, 25 and 30% protein) (F*L) which indicated that, these two factors act dependently on each other and also each of them had its own significant effect. The averages of initial Condition factor of *O. niloticus* were 1.87, 1.77, 1.73, 1.86, 1.79 and 1.82; while at the end of the experiment, the averages of body weight were 1.16, 1.35, 1.16, 1.19, 1.31 and 1.30, respectively for the treatments F1* L1, F1* L2, F1* L3, F2* L1, F2* L2 and F2* L3. As showed in this Table, the best final (K) was obtained for 3rd treatment (floating pellets, being 1.74) at protein level 30%.

Average Daily weight gain (ADWG):

Table (3) shows means of average daily weight gain (ADWG), during the experimental period as affected by food type (floating and sinking pellets). As described in this table, the ADWG of *O. niloticus* were 1.48 and 1.40 g/fish for floating and sinking pellets, respectively. These results indicate that, the DWG for floating pellets was higher than that obtained in sinking pellets. The differences between the two food types were significant ($P<0.05$). Abou-Zeid (2015) average daily weight gain (ADWG) were significantly ($P\leq0.05$) better with extruded floating diet, while lower values were recorded with extruded sinking diet.

With regard to the effect of protein level (L) on DWG, Table (3) showes that, the DWG was 1.36, 1.44 and 1.53g/fish for the three protein levels 20, 25 and 30% crude protien, respectively. These results indicated that, the average

DWG for protein level 30% was higher than the 20 and 25% crude protein. Analysis of variance of these results indicates that, the differences among treatments were significant (P<0.05). This result may be due to the increase in protein utilization and digestibility with the increase in dietary protein level.

Many authors obtained conflicting results from their studies on tilapia nutrition. The dietary protein requirements of several species of tilapia have been estimated to range from 20 to 56% (El-Sayed and Teshima, 1992). Siddiqui *et al*., (1988) reported an optimum dietary requirement of 40% for *O. niloticus* fry (initial weight. 0.838g), and 30% for young fish (initial weight, 40g). Jauncey (1982) and El-Sayed and Teshima, (1992) also reported 40% for fingerlings and fry respectively.

Kaushik *et al*. (1995) observed the maximum growth rates and feed efficiency at 35% dietary protein for the same species. Diyaware *et al*. (2009) revealed the best growth rate in hybrid catfish, *Heterobranchus bidorsalis* × *Clarias anguillaris* fry at 40% dietary crude protein level which also provided support to our finding.

Results presented in Table (3) also show that differences in DWG were significant (P<0.05) due to the interaction between food type (floating and sinking pellets) and protein levels (20, 25 and 30% protein) (F*L) which indicated that these two factors act dependently and due to changes in water quality and water conditions on each other and also each of them had its own significant effect. The averages of DWG of *O. niloticus* during the whole period were 1.39, 1.48, 1.57, 1.32, 1.40 and 1.49 g/fish for all treatments F1* L1, F1* L2, F1* L3, F2* L1, F2* L2 and F2* L3, respectively. As showed in this Table, the best DWG was obtained for 3rd treatment (floating pellets, being 1.57) at protein level 30%.

Specific growth rate (SGR):

Results in Table (3) shows that, means of Specific growth rate (SGR), during the experimental period as affected by food type (F) floating and sinking pellets. As described in this table, the averages of (SGR) of *O. niloticus* were

1.71 and 1.70%/day for floating and sinking pellets, respectively. These results indicate that, the (SGR) for floating pellets was higher ($P>0.05$) than obtained in sinking pellets.

Ajani *et al*. (2013) when studied the effects of feed forms and feeding frequency on growth performance and nutrient utilization of clarias gariepinus fingerlings. he reported that, Specific Growth Rate (SGR) of C. gariepinus fry fed floating and sinking diets at different feeding frequency. Fry fed sinking pellet thrice had the lowest SGR (0.52±0.01%) while fry fed floating pellet once and twice had the highest SGR. There was no significant difference in the SGR of fry fed twice with either floating (0.64±0.04%) or sinking pellet{0.60±0.71%).

With regard to the effect for protein level (L) on Specific growth rate (SGR) during the exprimental period, Table (3) showed that, the (SGR) was 1.68, 1.70 and 1.74%/day for three for the three protein levels (L), respectively. These results indicate that, the average Specific growth rate for protein level (30%) was higher than other protein levels. The analysis of variance of these results indicates that, the differences among treatments were significant ($P<0.05$).

This result was agreement with Abdoulaye (2013), he found that, specific growth rate of fish were improved significantly with increasing dietary protein levels from 21 to 37%

Results presented in Table (3) show that variations were significant ($P<0.05$) due to the interaction between food type (floating and sinking pellets) and protein levels (20, 25 and 30% protein) (F*L) which indicated that these two factors act dependently on each other and also each of them had its own significant effect. The averages of (SGR) of *O. niloticus* during the whole period were 1.69, 1.71, 1.74, 1.66, 1.70 and 1.73%/day for treatments F1* L1, F1* L2, F1* L3, F2* L1, F2* L2 and F2* L3, respectively. As showed in Table (3), the best Specific growth rate (SGR) was obtained for third treatment (floating pellets, being 1.74) at protein level 30%.

Total yield and Survival rate%:

Averages of total yield and survival rate at the end of the experiment are listed in Table (4). As described in Table (4) *O. niloticus* gained the highest yield and survival rate (9667.44 kg- 94.90%) from all ponds for floating pellets compared with 9111.29 kg – 93.62% gained by sinking pellets from all ponds. These results may be attributed to the effect of fed commercial floating diet to keep the diets available for fish.

As presented in this Table (4), third treatment (30% crude protein) gained the highest yield and survival rate (6646.09 kg - 94.80%), compared with (25% crude protein) (6254.72 kg – 94.39%) and 20% crude protein (5877.91 kg – 93.58%).

Table 4. Total yield and Survival rate as affected by feeding treatments.

Item	Yield (Kg)	Survival rate%
Food type (F)		
F1	9667.44	94.90
F2	9111.29	93.62
Protein level (P)		
L1	5877.91	93.58
L2	6254.72	94.39
L3	6646.09	94.80
Interaction between D*P		
F1* L1	3033.88	94.15
F1* L2	3207.16	95.06
F1* L3	3426.39	95.49
F2* L1	2844.03	93.02
F2* L2	3047.56	93.72
F2* L3	3219.70	94.11

Abou-Zied (2015) found that, total yield and survival rates of Nile tilapia were lower for extruded sinking diet than extruded floating diet. These values are in the normal ranges as indicated by Teichert- Coddington and Green (1993); Knud-Hansen and Batterson (1994); Hassouna *et al.* (1998); Abd El-Maksoud *et al.* (1999 a,b); Abou-Zied and Ali (2012) and Abou- Zied (2013) who reported values of tilapia survival rate ranged between 87 and 95%.

The interaction between between food type (floating and sinking pellets) and protein levels (20, 25 and 30% protein) was found to be significant. This may indicate that, for tilapia fish under the artificial feed with high level protein and floating pellets, the total yield of tilapia increased compared with other type feed and different protein levels. Third treatment 30% protein gained the highest yield and survival rate (3426.39 kg – 95.49%) with floating pellets, compared with third treatment 30% protein (3219.70 Kg – 94.11%) with sinking pellets, 25% protein (3207.16 Kg – 95.06%) with floating pellets, (3047.56 Kg – 93.72%) with sinking pellets, 20% protein (3033.88 Kg – 94.15%) with floating pellets and (2844.03 Kg – 93.02%) with sinking pellets.

Chemical composition:

The changes in chemical composition during development and in response to different factors are the result of differential growth of tissues (Table 5).

The main tissues involved in the whole-body growth are bones, muscles and adipose tissues. The relative development of these tissues is very important for the conformation of fish and thus its yield in processing (Soltan *et al.*, 1999).

Proximate analysis shows significant ($P \leq 0.05$) effects in the six treatments. As described in Table (5) floating diet released the highest values of protein, while sinking diet released the highest values of fat and ash. This closely met the remarks of Abou-Zied (2015) who emphasized that floating diet is commonly considered the most desirable for aquaculture because, at a given site, it is usually consistent in quantity and quality.

Data for protein and lipid content of the fish body in response to dietary levels could be divided into three groups. Data refers to fish which carcass protein and lipid content increased significantly ($P<0.05$) with increasing dietary protein levels.

Abdoulaye (2013); Ahmad *et al*. (2012); Tidwell *et al*. (2005) and Pedro *et al*. (2001) reported the increase in carcass protein content with the increase in dietary protein level.

In contrast, in the present study there was not any significant difference in protein body content of tilapia fed on five diets as compared to the initial fish. No relation between the dietary protein content and the carcass fat composition was observed. There was no defined trend identified in this study.

This is in contrast with results reported by (Ahmad *et al*., 2012) who reported that carcass lipid content exhibited positive relationship with dietary lipid level in tilapia and in rainbow trout reported by (Yamamoto *et al*., 2000 and Gumus and Ikiz, 2009).

Table 5. Least-square means and tested standard error of the factors affecting on chemical composition % DM basis of Nile tilapia.

Variable	No.	DM	CP	EE	Ash
F1* L1	6	27.70 ± 0.74^{b}	54.27 ± 2.64^{b}	13.17 ± 0.32^{c}	11.56 ± 0.28^{ab}
F1* L2	6	27.52 ± 0.74^{b}	54.72 ± 2.64^{b}	13.53 ± 0.32^{c}	11.27 ± 0.28^{ab}
F1* L3	6	27.09 ± 0.74^{b}	55.85 ± 2.64^{a}	14.08 ± 0.32^{b}	10.96 ± 0.28^{b}
F2* L1	6	28.84 ± 0.74^{a}	53.04 ± 2.64^{c}	14.30 ± 0.32^{b}	$12.05 \pm 0.28b^{a}$
F2* L2	6	28.97 ± 0.74^{a}	53.96 ± 2.64^{bc}	15.21 ± 0.32^{a}	12.76 ± 0.28^{a}
F2* L3	6	27.81 ± 0.74^{b}	54.27 ± 2.64^{b}	15.67 ± 0.32^{a}	11.45 ± 0.28^{ab}

[a, b, c, d] Means of the same row with different superscripts are significantly.
Means with the same letter in each column are not significantly different ($P \geq 0.05$).

Economic evaluation:

Results of costs including variable, fixed coasts and interest on working capital for the treatments applied are shown in Table (6). Results of this Table revealed that costs of fingerlings of Nile tilapia are similar in all treatments applied; however, the feed costs differed according to food types and weight increasing. The lowest for treatment1, artificial feeding only 36221.87 LE/fed, for first treatment and increased to 42241.59, 48814.23, 34249.72, 39039.79 and 47156.74 LE/fed, for other treatments, respectively.

Table 6. The effect of the experimental factors on economic efficiency (LE/Fed).

Items	2012			2013		
	T1	T2	T3	T1	T2	T3
A-Variable costs (LE/Fed)						
1-Fish production						
a. *O. niloticus* fingerlings	2640	2640	2640	2640	2640	2640
b. Feeds	36221.88	42241.59	48814.23	34249.72	39039.79	47156.74
c. Poultry manure	640	640	640	640	640	640
d. Triple supper phosphate	228.8	228.8	228.8	228.8	228.8	228.8
e. Urea	57.2	57.2	57.2	57.2	57.2	57.2
Total variable costs (LE/Fed)	39787.88	45807.59	52380.23	37815.72	42605.79	50722.74
B- Fixed costs (LE/Fed,)						
a. Depreciation (materials & others) 10%	900	900	900	900	900	900
b. Taxes	650	650	650	650	650	650
Total fixed costs (LE/Fed)	1550	1550	1550	1550	1550	1550
Total operating costs (variable & fixed)	41337.88	47357.59	53930.23	39365.72	44155.79	52272.74
Interest on working capital *	3504.09	4014.367	4571.51	3336.92	3742.96	4431.01
Total costs	44841.97	51371.96	58501.74	42702.64	47898.75	56703.75
% of the smallest value	105%	120%	137%	100%	112%	133%
Returns						
Total return (LE/Fed)	50059.02	57728.88	66814.70	46926.41	54856.08	62784.15
Net return (LE/Fed)	5217.05	6356.92	8312.96	4223.77	6957.33	6080.40
% of the smallest value of net return	123.52%	150.50%	196.81%	100%	164.718%	143.96%
% Net returns to total costs	11.63%	12.37%	14.21%	9.89%	14.52%	10.72%

* 17% × total operating costs × 140/365 days.

****** The economical evaluation of results was carried out according to market prices in 2015 in LE.

O. niloticus = LE 220 /1000 fry (2015),

Urea =LE 2200/1000 Kg (2015). Triple supper phosphate = LE 2000/1000 Kg (2015).

Manure = LE 900/1000 Kg (2015).

Fish feed (20% protein) = LE 4300/1000 Kg (2015),

LE 4350 /1000 Kg (2015).

Fish feed (25% protein) = LE 4700/1000 Kg (2015),

LE 4750 /1000 Kg (2015).

Fish feed (32% protein) = LE 5200/1000 Kg (2015),

LE 5250 /1000 Kg (2015).

Total costs per fed, increased for treatment 4, (42702.64 LE- 100%) and increased to, (44841.97 – 105%), (51371.96 – 119%), (58501.74046 – 137%), (47898.75 – 114%) and (56703.75 LE – 130%) for other treatments treatment1 and treatment3, treatment5, and treatment6, respectively. Differences in total costs were attributed to the differences in feed costs and organic and inorganic fertilizer additives.

Total returns in LE/fed, for treatment 1, treatment 2, treatment 3, treatment 4, treatment 5 and treatment 6 were 50059.02, 57728.88, 66814.70, 46926.41, 54856.08 and 62784.16 respectively (Table 6).

Net returns/pond in LE were found to be 5217.05, 6356.92, 8312.96, 4223.77, 6957.33 and 6080.40 LE for all treatments T1, T2, T3, T4, T5 and T6, respectively. The percentage of net return to total costs were 11.63, 12.37, 14.21, 9.89, 14.52 and 10.72%% for all treatments T1, T2, T3, T4, T5 and T6 respectively.

These results of economic evaluation indicate that, 30% crude protein in floating pellets was higher than that obtained in sinking pellets or low protein percentages in fish diet.

CONCLUSION

Based on results obtained in this study and on the economical evaluation, it could be concluded that, floating pellets was best than sinking pellets, in addition to the increasing of protein percentage in diet was best in terms of economic efficiency compared to other treatments.

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تقييم إستخدام العلف الطافي والغاطس فى تربية إصبعيات أسماك البلطى النيلى فى الأحواض الترابيه

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الملخص العربي

اجريت هذه الدراسة في مزرعة سمكيه خاصة بمنطقة ٥٦– مركز الرياض محافظة كفر الشيخ في الفترة من ٢٠١٦/٥/١حتى ٢٠١٦/١١/١ لمدة ٦ شهور لدراسة تأثير العلف الطافي والغاطس على انتاجية الاسماك أجريت تجربة علمية (٢معامل×٣مستويات) لتقييم نوعين من الحبيبات أعلاف التغذية (حبيبات طافى وغاطسة) وثلاثة مستويات بروتينية (٢٠ ، ٢٥ ، ٣٠٪)، لذلك تمت إعداد ٦ وجبات غذائية واختبارها في ١٢ حوض ترابى (عدد ٢مكرر لكل معاملة). تم تخزين ١٢٠٠٠ إصبعية من أسماك البلطى النيلى لكل حوض (١ فدان) بمعدل ١٢.٤٦ ± 1.27 جرام. في نهاية التجربة (٢٦ اسبوعا). يمكن تلخيص النتائج التي تم الحصول عليها على النحو التالي:

سجل نظام التغذية على العلائق الطافية أعلى معدل من وزن الجسم، طول الجسم، معامل الحالة، وزيادة الوزن اليومي ومعدل النمو النوعى. سجل نظام التغذية على ٣٠٪ بروتين خام أعلى معدل من وزن الجسم، طول الجسم، معامل الحالة، وزيادة الوزن اليومي ومعدل النمو النوعى.

واستنادا إلى النتائج التي تم الحصول عليها في هذه الدراسة وعلى التقييم الاقتصادي، يمكن استنتاج أن الحبيبات العائمة كانت أفضل من الحبيبات الغاطسة، بالإضافة إلى أن زيادة نسبة البروتين في النظام الغذائي أعطت أفضل أداء إنتاجي وكفاءة اقتصادية مقارنة مع غيرها من المعاملات الاخرى.