

## **EFFECT OF DIET EXTRUDED TYPE ON GROWTH PERFORMANCE, FEED UTILIZATION AND ECONOMIC EFFICIENCY OF NILE TILAPIA IN COMMERCIAL FARMS**

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### **SUMMARY**

**T**his study aimed to evaluate the effect of extruded diets (floating and sinking) on growth parameters, feed utilization and economic efficiency of Nile tilapia (*Oreochromis niloticus*) cultured in commercial farms. A total number of (100000) mono sex Nile tilapia fingerlings of  $5.27 \pm 0.01$  g initial body weight in average were allotted randomly into four earthen ponds (two feddan/each). Two diets were used extruded floating diet (EFD) and extruded sinking diet (ESD), from zoo control company. The diets contained the same level of protein, carbohydrate and fat as formulation and ingredients of the experimental diets were the same. Each diet contained in average 27.37% CP and 4.57 kcal/g GE. Fish were fed pelleted extruded diet type at a rate of 3% of the total body weight and was adjusted every month intervals until harvesting. Results cleared that final mean weight and weight gain were significantly ( $P \leq 0.05$ ) better with EFD, while lower values were recorded with ESD, but daily gain and specific growth rate insignificantly affected by diet type. Feed intake was significantly decreased with EFD. FCR values were significantly better with EFD than ESD. Survival rates insignificantly affected and ranged between 87.23 and 92.10%. Net returns and profit index were significantly high with EFD than sinking diet.

In conclusion regarding to final weight, survival rate, net returns and profit index, the EFD was best feed if served suitable environmental condition specially low wind speed and lack of birds.

**Keywords:** *Nile tilapia, extruded floating, sinking diet, growth performance, feed utilization and economic efficiency.*

### **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 tonnes in 1992, representing 18.5% of total Egyptian fish production to reach 1,017,738 tonnes in 2012, contributing 74% of total production (FAO, 2013 and 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).

There are few species used in aquaculture. Some of which are native while few are introduced. However, three groups comprise more than 95% of aquaculture production and their percentage contributions to total production are tilapias (75.54%), mullet (12.74%) and carps (6.59%). There are promising practices for African catfish farming. While tilapia is steadily increasing, carps are declining due to marketing problems (GAFRD, 2012). Tilapia has the advantage of being quite tolerant of various water qualities, even a slight salt content (not all species, but several fast-growing kinds of tilapia). And they require no antibiotics if done right, so it can be the ideal fish for a developing economy, as long as labor and land prices are low.

Aquaculture plays a major role in supplying affordable animal protein for Egyptians and current policies support intensification and higher production levels. Egypt is among the ten largest producers of farmed fish (mostly tilapia) globally (FAO 2012).

The artificial feeding is considered supplementary feeding to help the natural growth of fish quickly during a culture period which varies depending on the type of fish farmed. Macfadyen *et al.* (2011) reports that there are 25 fish feed mills in Egypt, producing more than 300,000 Mt of fish feed each year. Increasing world market prices of raw materials resulted in an increase of feed prices with 200 – 250% over the last 6 – 7 years (Macfadyen *et al.*, 2012).

El-Sayed *et al.* (2015) reported that about 90% of Egyptian aquafeeds 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 t/year and with total annual production of 120,000 to 240,000t (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/t (El-Naggar *et al.*, 2011).

## MATERIALS AND METHODS

This study was conducted at a commercial farm located in WadiEl-Rayan region, Fayoum Governorate, Egypt, it started at 11/4/2014 and terminated at the 21/11/2014 (223 days period).

A total number of (100000) mono sex Nile tilapia (*Oreochromis niloticus*) fingerlings of  $5.27 \pm 0.01$  g initial body weight in average that obtained from nursing pond located at the same farm. The fish were allotted randomly into four earthen pond (twofeddan/each). Accordingly 25000 fish were stocked/each earthen pond.

Two diets were used, extruded floating diet (EFD) and extruded sinking diet (ESD), from zoo Control Company. The diets contained the same level of protein, carbohydrate and fat as formulation and ingredients of the experimental diets were the same. Each diet was analyzed according to AOAC (1990) and contained in average 27.37% CP and 4.57 kcal/g GE as indicated in Table (1). Fish were fed pelleted extruded diet type at a rate of 3% of the total body weight until harvesting. Fingerlings were fed 3 times daily at 8 and 11 am and 4 pm 6 days/week. Extruded floating diets were thrown from pond bridge to the inside rectangular wooden frame on the surface of pond water to prevent feed spread on pond by wind, and feeders were covered with invisible plastic net to protect feed from birds. Extruded sinking diets were thrown from Pond Bridge on a wooden feeders fixed bottom the water's surface by about 25-30 cm with mud from plastic jerry cans. Feed amount was adjusted every month intervals.

### Parameters measurements:

At the end of the experiment, growth parameters and survival rate were measured as follows:

- Weight gain = Final weight - Initial weight (Effiong *et al.*, 2009).
- Daily gain = Weight gain, g /period in days. (Effiong *et al.*, 2009).

**Table (1): Proximate analysis of extruded diet type used (on DM basis).**

Items	Extruded diet	
	Floating	Sinking
DM	90.21	89.85
Crude protein, CP	27.24	27.51
Ether extract, EE	7.43	7.82
Ash	8.94	8.68
Crude fiber, CF	4.86	4.93
Nitrogen free extract. NFE <sup>1</sup>	51.53	51.06
GE, kcal/g <sup>2</sup>	4.555	4.591

<sup>1</sup>Calculated by differences,  $NFE = OM - (CP + EE + CF)$ .

<sup>2</sup>Calculated according to NRC (1993).

- *Specific growth rate (SGR, %)* =  $100 (\ln \text{ Final weight} - \ln \text{ Initial weight}) / \text{period in days}$ , where  $\ln$  is the natural log. (Effiong *et al.*, 2009).
- *Feed conversion ratio (FCR)* =  $\text{feed offered} / \text{weight gain}$  (Effiong *et al.*, 2009).
- *Survival rate (SR) %* =  $\text{Final number of fish} / \text{Initial number of fish} \times 100$ . (Charo-Karisa *et al.*, 2006).

A simple economic analysis was used to assess the cost effectiveness of diets used in the feed trial. The cost of feed was calculated using market prices taken into consideration the cost of feed and the transport fare with the assumption that all other operating costs remained constant (e.g. cost of constructing, cost of fingerlings and labour).

- *Profit index (PI)* =  $\text{Value of fish produced} / \text{feed costs}$  (Abu *et al.*, 2010).

**Water quality parameters:**

Water temperature, pH, dissolved oxygen (DO) and total ammonia throughout experimental periods were measured periodically every week in the morning and at noon by centigrade thermometer, Orion digital pH meter model 201, HANNA HI 9146 oxygen meter, HACH test kit ammonia mid-range 0-3 mg/L model NI-8.

**Statistical Analysis:**

Data were statistically analyzed in a one- way analysis of variance using SPSS (2012). Mean of treatments were compared by Duncan (1955) multiple range test when the variance analysis was significant.

**RESULTS AND DISCUSSION**

**Water quality:**

Results of water quality parameters of Nile tilapia as affected by receiving extruded diets type during the experimental period (223 days) are presented in Table (2). In general, average of water temperature was 28.5 for both treatments. This result is in agreement with those of Boyd, (1983); Jobling, (1983) and Abdel –HaKim *et al.*(2000), who found that the optimum temperature ranged between 15 and 30°C for Nile tilapia (*Oreochromis niloticus*). Averages of pH values were 7.79 and 7.74 for EFD and ESD, respectively, these values were suitable for Nile tilapia.

**Table (2): Water quality parameters recorded during the experimental period.**

Month	Temperature, °C		pH		Dissolved oxygen, mg/l		Ammonia, mg/l	
	EFD	ESD	EFD	ESD	EFD	ESD	EFD	ESD
April	27	27	7.84	7.87	10.89	10.80	0	0
May	28	28	7.73	7.78	10.57	10.73	0	0
June	29	29	7.59	7.64	10.64	10.31	0.2	0.2
July	30	30	7.68	7.78	9.94	9.72	0.2	0.2
August	30	30	7.83	7.88	9.35	8.67	0.2	0.4
September	29	29	7.82	7.52	8.48	7.64	0.4	1.0
October	28	28	7.91	7.74	8.94	7.50	0.4	1.60
November	27	27	7.88	7.69	8.83	7.20	0.6	2.0
Average	28.5	28.5	7.79	7.74	9.71	9.07	0.25	0.66

*EFD: Extruded floating diet    ESD: Extruded sinking diet*

The concentrations of dissolved oxygen (mg/L) for EFD and ESD were 9.71 and 9.07 mg/L, respectively. These values are beneficial to fish culture and indicate that water dissolved oxygen was suitable. These results are in agreement with Boyd (1992), who reported that levels of dissolved oxygen above 4 ppm is considered a limiting factor, below which, fish may live but can't feed or grow well.

The average concentrations of total ammonia were 0.25 and 0.66 mg/l for EFD and ESD, respectively these values equal 0.012 and 0.033 unionized ammonia calculated according to Florida Department of Environmental Protection (2001). The high total ammonia concentration in ponds fed ESD compared with ponds fed EFD is a result of analyzed part of sinking diets and mixed with mud, raising total ammonia (which within safe limits), these results are far than toxic level of unionized ammonia (2 mg/l) that reported by the European Inland Fisheries Advisory Commission (1993).

In general water quality parameters measured were suitable for the normal growth of tilapia. Such trend was mentioned by Stickney (1986); Tahoun (2007) and Khalfalla *et al.* (2008).

**Growth performance:**

Data of growth performance are presented in Table (3). There were no significant differences ( $P \leq 0.05$ ) in daily gain and SGR among fish fed different diets.

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. 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 nor 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 fed ESD compared with ponds fed EFD (which within safe limits), which affect the fish growth rates. These results are agreements with the results obtained by Hematzade *et al.* (2013) with rainbow trout and disagreed with that obtained by Kristiansen and Ferno (2007).

**Table (3): Effect of extruded diet type on growth performance parameters of Nile tilapia reared in commercial earthen ponds.**

Parameters	Extruded diet		SED
	Floating	Sinking	
Initial mean body weight, g	5.27	5.26	0.03
Final mean body weight, g	303.71 <sup>a</sup>	276.67 <sup>b</sup>	8.87
Total gain, g	298.44 <sup>a</sup>	271.41 <sup>b</sup>	8.88
Daily gain, g	1.33	1.27	0.19
SGR, %	1.81	1.77	0.016

\* Average in the same row having different superscripts differ significantly  $P \leq 0.05$ .

\* SED, standard error of a difference between 2 means =  $\sqrt{2 \times \text{Error MS}/r}$

**Feed utilization:**

Feed intake, feed conversion ratio (FCR) and survival rate of fish fed extruded diet type are shown in Table (4). Feed intake was significantly decreased with extruded floating diet. FCR values were significantly different between extruded diets ( $P \leq 0.05$ ), the best FCR was recorded in EFD (extruded floating diets). The highest FCR was recorded with ESD (extruded sinking diets). Improved FCR on fish fed EFD compared with fish fed ESD is probably due to less feed consumed with high growth and fish was benefit of all diet that given at each meal if they are protected from birds. These results agree with that of Hematzade *et al.* (2013) with rainbow trout.

**Table (4): Effect of extruded diet type on feed utilization of Nile tilapia reared in commercial earthen ponds.**

Parameters	Extruded diet		SED
	Floating	Sinking	
Feed intake, g/fish	446.45 <sup>b</sup>	485.00 <sup>a</sup>	9.71
FCR	1.50 <sup>b</sup>	1.79 <sup>a</sup>	0.03
Survival rate%	92.10 <sup>a</sup>	87.23 <sup>b</sup>	1.27
Feed intake, kg/pond	10275 <sup>b</sup>	10825 <sup>a</sup>	79.06

\* Average in the same row having different superscripts differ significantly  $P \leq 0.05$ .

\* SED, standard error of a difference between 2 means =  $\sqrt{2 \times \text{Error MS}/r}$ .

Usually, it is advantageous to feed a floating (extruded) feed, because the farmer can directly observe the feeding intensity of his fish. The use of floating diets saves about 25% of the feed that would otherwise be lost from the pond if sinking diets used (El-sayed, 2013).

Survival rates of Nile tilapia were 87.23 and 92.10% for ESD and EFD, respectively. These values are in the normal ranges as indicated by Teichert-Coddington and Green (1993), Knud-Hansen and Batterson (1994), Hassouna *et al.* (1998) and Abd El-Maksoud *et al.* (1999 a,b), Abouzied and Ali (2012) and Abouzied (2013) who reported values of tilapia survival rate ranged between 87 and 95%.

**Economic evaluation:**

The effect of extruded diet type on economic evaluation was shown in Table (5). Increased cost of ESD result of increased feed intake compared to EFD. Increase fish production on ponds fed EFD in a good growth rates significantly increased in final weight and increased the proportion of large fish (first and second grade in Marketing), which was characterized by rising selling prices with the low percentage of marketing small fish causing the high sales of fish fed on EFD compared with fish fed ESD.

**Table (5): Effect of extruded diet type on economic efficiency of Nile tilapia reared in commercial earthen ponds.**

Parameters	Extruded diet		SED
	Floating	Sinking	
Costs, L.E. /pond			
Feed	51375 <sup>b</sup>	54125 <sup>a</sup>	395
Fish	1500	1500	---
Other costs	11150	11150	---
Total costs	64025 <sup>b</sup>	66772 <sup>a</sup>	395
Pond biomass, kg			
First grade	5860 <sup>a</sup>	4625 <sup>b</sup>	300
Second grade	825	800	218
Third grade	305 <sup>b</sup>	750 <sup>a</sup>	5.52
Total fish selling price, L.E	102500 <sup>a</sup>	88075 <sup>b</sup>	3292
Net returns	38475 <sup>a</sup>	21300 <sup>b</sup>	3275
Profit index	1.98 <sup>a</sup>	1.63 <sup>b</sup>	0.005

Price of one kg selling fish of first grade, 3 fish/kg = 15 L.E

Price of one kg selling fish of second grade, 4 fish/kg = 14 L.E

Price of one kg selling fish of third grade, in average 7 fish/kg = 10 L.E

Price of kg feed = 5 L.E.

SED, standard error of a difference between 2 means =  $\sqrt{2 \times \text{Error MS}/r}$ .

Feeding extruded floating diet lead to increase final body weight and improved fish graded at harvesting resulted improved net returns than extruded sinking diets. The total costs were 64025 and 66775 L.E /pond for the EFD and ESD, respectively. The corresponding values of net returns in L.E per pond were 38475 and 21300, respectively.

Profit index were significantly differences ( $P \leq 0.05$ ) and the values were 1.98 and 1.63 for EFD and ESD, respectively indicating that the highest returns were obtained with extruded floating diet.

In conclusion regarding to final weight, survival rate, net returns and profit index, the extruded floating diets was best feed if served suitable environmental condition specially low wind speed and lack of birds.

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## تأثير نوع العليقة الميثوقة على مظاهر النمو والاستفادة من الغذاء والكفاءة الاقتصادية للبلطى النبل فى المزارع التجارية.

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هدفت هذه الدراسة الى تقييم تأثير نوع العليقة الميثوقة (طافية او غاطسة) على مظاهر النمو والاستفادة من الغذاء والكفاءة الاقتصادية للبلطى النبل فى المزارع التجارية. وزع 100 الف اصبعية بلطى وحيد الجنس بمتوسط وزن ابتدائى 5.27 جم عشوائيا على اربع احواض ترابية (2 فدان/حوض) تم استخدام عليقتان ميثوقتان (طافية و غاطسة) من شركة نوكنترول تحتويان نفس مستوى البروتين والكربوهيدرات والدهون حيث تحتوى 27.37% بروتين خام و 4.57 كيلوكالورى/جم. تغذت الاسماك على العلائق بمعدل 3% من الوزن عدلت كل شهر حتى الحصاد.

اوضحت النتائج ان الوزن النهائى والزيادة فى الوزن تحسنت معنوياً مع العليقة الطافية وانخفضت قيمها مع العليقة الغاطسة أما الزيادة اليومية ومعدل النمو النوعى لم يتأثر معنوياً أما الغذاء المأكول انخفض معنوياً مع العليقة الطافية واختلف معدل التحويل الغذائى معنوياً وكان احسن معدل تحويل مع العليقة الطافية. لم تتأثر نسبة الاعاشة معنوياً وتراوحت بين 87.23 و 92.10 للعليقة الغاطسة والطافية على التوالى وارتفع صافى الربح ودليل الربحية معنوياً لصالح العليقة الطافية. بالنظر الى الوزن النهائى ومعدل الاعاشة وصافى الربح تعتبر العليقة الطافية افضل من الغاطسة اذا توفرت الظروف المناسبة من حيث انخفاض او عدم وجود رياح او طيور