EFFECT OF HOT PEPPER AS A FEED ADDITIVE ON REPRODUCTIVE AND PRODUCTIVE PERFORMANCE OF NILE TILAPIA (*OREOCHROMIS NILOTICUS*)

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Received 6/ 1/ 2014 *Accepted 18/ 2/ 2014*

Abstract

This study was conducted to evaluate the effect of five hot pepper levels (0.1%, 0.2%, 0.3%, 0.4%, and 0.5%) on the reproductive performance of Nile tilapia (*Oreochromis nloticus*), kept in hapas (4 m × 7 m × 1.2 m) suspended in an earthen pond. Fish (250 gm ± 2.35) were stocked for spawning into twelve hapas at a density of 120 fish (90 female and 30 male) per hapa /treatment. Fish fed the tested diets twice daily at a rate of 0.6 from their total biomass. Water quality parameters were measured weekly. Production of seed (i.e eggs and fry production) were compared with levels of hot pepper in the commercial diet. The results revealed that the reproductive and growth Performance (number of egg /female, number of fry /female, and hatchability) improved significantly by increasing hot pepper levels in the commercial diets. Fish fed from 0.1% to 0.4% hot pepper showed the highest performance while fish fed 0.5% hot pepper and control diet showed the lowest performance. In conclusion it seems that the 0.4% hot pepper level in commercial diet was the best compared the different levels of hot pepper followed by the 0.3%, 0.2% 0.1% and 0.5% hot pepper levels than control treatment respectively

Key wards: Nile tilapia, reproductive performance, Hot pepper

INTRODUCTION

Fish sector contributed by 8.5% in national agriculture income, fish production from aquaculture activities contributed 74% of the total fish

production which amounted 1.305 million metric tons, tilapia acts as 63.48 % of them (GAFRD 2012).

Tilapia has become popular for farmers as it is easy to culture and there is a good demand in the market. Moreover, tilapias (*Oreochromis spp.*) adapt well to the local environment and local feed, and have high productivity (Sorphea *et al.*, 2010). For many years, tilapia has drawn attention of the farmers for their better growth performance. It rank high in global aquaculture production after salamons and carps (FAO, 2012). Tilapias are a hardy species produced by several culture methods under a wide range of environmental conditions in tropical and subtropical regions in developing countries and it can be cultured in mesh cages that maintain free circulation of water. It ensures flexibility in management practices with easy and low cost of harvesting.

Hot Pepper (*Capsicum annum L*) commonly used in diet and traditional medicine, were assessed for their antioxidant potential (Shahverdi *et al.*, 2013). Antimicrobial peptides are very efficient in inhibiting growth in human and plant pathogenic bacteria and fungi. Hot red pepper (*Capsicum annum L*) is one of the most important herbs, which is widely used in human feed all over the world. It originated from central and South America and it's belonged to Solanaceae family, genus *Capsicum.* It frequently consumed as spices throughout the world (Kobata *et al*., 1998). Hot pepper fruits contain the chemical group of alkaloid compounds called capsaicinoids, which are responsible for the pungency of the *Capsicum* species. Wesolowska *et al.* (2011) reported that the major components of the extracts are capsaicin, dihydrocapsaicin and nonivamide (pelargonic acid vanillylamide).

Capsaicin (CAP, 8-methyl-N-Vanilly-6-nonenamide) is the active substance responsible for the irritating and pungent effects of various species of hot pepper. CAP has emerged as a relatively selective

neurotoxin for small-diameter sensory neurons (Jessel *et al*., 1978; Nagy *et al*., 1981; Mitsuhiro *et al*., 1994 and Jancso *et al*., 1997).

Al-Kassie *et al.* (2011) reported that the use of (HRP) as feed additive at 0.50%, 0.75% and 1% enhanced the overall performance of broiler chicks. Shahverdi *et al.* (2013) concluded that the use of red and black pepper as feed additive at 1% enhanced the overall performance of broiler chicks.

The present work was conducted to evaluate the effect of hot pepper as a feed additive in reproductive performance and body weight of Nile tilapia (*Oreochromis niloticus*) reared in hapas.

MATERIALS AND METHODS

The present study was conducted in commercial farm at El-Garak village, El-Fayoum Governorate, Egypt, for 65 days to determine the most suitable level of hot pepper (0.1%, 0.2%, 0.3%, 0.4% and 0.5%) beside the control diet (0.0 hot pepper) in Nile tilapia (*Oreochromis niloticus*) diets and their effect on their reproductive and productive performance.

One year old Nile tilapia (*Oreochromis niloticus*) averaging 250 g ± 2.35 in weight were stocked for spawning into twelve hapas, (each of 7 m length × 4 m width × 1.2 m height); two hapa per each treatment. Hapas were fixed in an earthen pond, (one feddan area × 1 m. depth) with water level of 90 cm, about 1/3 of the water level was exchanged with fresh water every 3 days, such ponds were aerated with air diffuser. The distance between hapas of each treatment was not less than 10 m.

Water temperature (C°), dissolved oxygen (DO) mg/L and pH during the experimental period were measured by centigrade thermometer, oxygen meter, Cole Parmer model 5946 and Orion digital pH meter model 201 respectively and showed in Table 1.

Fish were stocked at a density of 120 fish (90 female and 30 male) per hapa. Fish were fed on the tested diets (Table 2) at a rate of 0.6% from their body weight, twice daily at 9 h and 15 h. Fish body mass was determined at two week intervals weighting for the next period.

Production of seed (i.e., eggs and fry production) was compared with the tested diets. Broodstock were checked for eggs every 10 days early in morning. Females carrying the eggs were taken from the hapa and returned after taking out of eggs. Eggs were taken to hatchery laboratory, and then were washed by potassium permanganate solution to prevent bacterial and fungal infection. The eggs were transferred into the jars. Eggs/hapa were counted, and then placed for hatching in 15L plastic jars, continuous flow of water was maintained until hatching. The number of eggs, number of fry/ fish and hatching percentage were calculated. Feed used were determined and the cost of feed/ 1000 fry produced were calculated. Also, fish total gain, average daily gain and specific growth rate (SGR) were obtained.

Reproductive performance parameters were measured as follow:

Egg No./femal =(Egg No./hapa)/(Spawned femal No./hapa).

Fry No./femal =(Fry No./hapa)/(Spawned femal No./hapa).

Hatching % = =(Fry No./hapa)/(Egg No./hapa)*100.

Total gain (TG, g) =W2-W1.

Average daily gain (ADG, g) =(TG,g)/(trial period ,days).

Specific growth rate (SGR %, g/day) = 100 (lnW2 – lnW1)/T.

The cost of feed/1000fry (LE) = Feed required to produce 1000 fry, kg × 4.2 (price of kg feed)

The data were analyzed by one way analysis of variance. Duncan's Multiple Range test was applied. All statistics were carried out using statistical analysis systems (SAS, 2004).

Table (1) Formulation and proximate composition of the tested deities

Ingredient	Hot pepper levels %					
	0	0.1	0.2	0.3	0.4	0.5
Fish meal[1]	30	30	30	30	30	30
Soya bean[2]	15	15	15	15	15	15
Rice bran	21	21	21	21	21	21
Wheat bran	16	16	16	16	16	16
Yellow corn	14	13.9	13.8	13.7	13.6	13.5
Molases	2.75	2.75	2.75	2.75	2.75	2.75
Dicalceium phosphate	1	1	1	1	1	1
Vit. and Min. premix[3]	0.25	0.25	0.25	0.25	0.25	0.25
Hot pepper	0	0.1	0.2	0.3	0.4	0.5
Total	100	100	100	100	100	100
Proximate compassion % (DM basis)						
Dry matter (DM)	89.57	89.53	89.47	89.5	89.51	89.45
Crude protein (CP)	34.57	34.31	34.27	34.56	34.44	34.39
Crude fat (EE)	6.25	6.39	6.32	6.50	6.13	6.44
Crude fiber (CF)	5.59	5.48	5.44	5.52	5.38	5.62
NFE[4]	43.98	44.31	44.47	43.70	44.72	44.09
Ash	9.43	9.51	9.50	9.72	9.33	9.46
GE[5], Kcal/Kg	4584	4584	4581	4586	4580	4591

1.Fish meal herring 999 (72% CP)

2.Soya bean meal (44% CP)

3. Emedest Farma Company

4 . NFE (Nitrogen free extract) = 100 – (protein% + lipid% + ash% + fiber%)

5. GE (gross energy) =(5.64 × CP %)+ (9.44 × EE%)+(4.11 × NFE%)+ (4.11×fiber%) (NRC, 1993).

RESULTS AND DISCUSSIONS

Means of water temperature and other quality parameters (Dissolved oxygen and water pH) are presented in Table (2). Water temperature and other quality parameters were within the permissible ranges for tilapia growth and reproduction as reported by Siddiqui *et al.* (1998) and Ali (2001).

Table (2) Means of water quality parameters recorded during the experimental period (65 days)

Parameter	**T_6**	**T_5**	**T_4**	**T_3**	**T_2**	**T_1**
Temperature (C)	28.0± 0.22	28.0± 0.20	28.0± 0.18	28.0± 0.23	28.0± 0.19	28.0± 0.18
Oxygen (DO) Mg/ L	5.56± 0.12	5.53± 0.11	5.50± 0.12	5.52± 0.11	5.50± 0.11	5.52± 0.11
pH	8.20± 0.03	8.10± 0.02	8.10± 0.02	8.10± 0.02	8.10± 0.01	8.10± 0.01

Reproductive performance parameters of Nile tilapia broodstock acts on egg number/female as affected by dietary hot pepper level is shown in Table (3). The result showed improved egg number as hot pepper level increased in diets till 0.4% then decreased at 0.5%. The best treatment was T_5 which contained 0.4 % hot pepper followed by T_4, T_3, T_6, and T_2. These increased by about 23, 12, 11, 8 and 8% than the control (T_1), respectively.

Table (3) Average of egg number/ female of Nile tilapia fed different levels of hot pepper for 5th harvest during the experimental period (65 days).

Treatments	Harvest number					Total period
	1st	2nd	3rd	4th	5th	
T_1 (0.0)	522.0^{e} ±12.0	470.0^{e} ±17.0	360.0^{e} ±9.0	338.0^{e} ±11.0	336.0^{e} ±9.0	2026.0^{f} ±25.7
T_2 (0.1% HP)	577.5^{C} ±13.0	525.0^{C} ±8.0	390.0^{ed} ±12.0	364.0^{Cd} ±9.0	335.5^{d} ±7.0	2192.0^{e} ±30.6
T_3 (0.2% HP)	591.0^{b} ±10.0	521.5^{C} ±7.0	402.5^{C} ±14.0	367.5^{C} ±8.0	365.0^{b} ±6.0	2247.5^{c} ±30.5
T_4 (0.3% HP)	593.5^{b} ±9.0	537.5^{b} ±6.0	408.5^{b} ±15.0	365.0^{b} ±6.0	365.0^{b} ±8.0	2269.5^{b} ±31.5
T_5 (0.4% HP)	650.0^{a} ±11.0	582.0^{a} ±15.0	456.0^{a} ±16.0	415.0^{a} ±13.0	390.0^{a} ±11.0	2493.0^{a} ±33.6
T_6 (0.5% HP)	572.5^{d} ±15.0	503.5^{d} ±11.0	403.0^{d} ±14.0	355.0^{d} ±9.0	362.0^{c} ±9.0	2196.0^{d} ±28.6

- Means having the same letter in the same column are significantly different at P≤0.05

Fry number/female as affected by dietary hot pepper level is shown in Table (4). The result takes the same trend of egg number and showed that improved fry number as hot pepper level increased in diet till 0.4% then decreased at 0.5%. The best treatment was T_5 which contained 0.4 % hot pepper followed by T_4, T_3, T_6, and T_2. These increased by about 23, 12, 11, 8 and 8% than the control (T_1), respectively.

Table (4) Average of fry number /female of Nile tilapia fed different levels of hot pepper for 5th harvest during the experimental period (65 days).

Treatments	Harvest number					Total period
	1st	2nd	3rd	4th	5th	
T_1 (0.0)	411.0^{e} ± 10.0	376.5^{e} ±15.0	287.0$^{.e}$ ±13.0	272.0^{e} ±15.0	272.0^{e} ±9.0	1618.5^{f} ±19.7
T_2 (0.1% HP)	465.0^{d} ±12.0	424.5^{C} ±12.0	313.5^{c} ±12.0	293.5^{c} ±12.0	289.0^{c} ±8.0	1785.5^{e} ±24.5
T_3 (0.2% HP)	478.5^{c} ±13.0	428.5^{C} ±12.0	320.0^{C} ±11.0	298.0^{C} ±14.0	290.0^{c} ±4,0	1815.0^{c} ±24.8
T_4 (0.3% HP)	486.0^{b} ±9.0	437.5^{b} ±17.0	336.5^{b} ±14.0	302.0$^{.b}$ ±14.0	299.0^{b} ±9.0	1861.0^{b} ±25.5
T_5 (0.4% HP)	542.5^{a} ±11.0	490.5^{a} ±13.0	383.5^{a} ±15.0	349.0^{a} ±13,0	327.0^{a} ±11.0	2092.5^{a} ±27.9
T_6 (0.5% HP)	460.5^{d} ±1.0	413.5^{d} ±12.0	332.0^{d} ±16.0	294.0$^{.d}$ ±17.0	299.0^{d} ±18.0	1799.0^{d} ±22.2

- Means having the same letter in the same column are significantly different at P≤0.05

Table 5 showed the hatching % as affected by hot pepper level and no significant differences were shown because the hatching % depended on the laboratory management and water quality.

Table (5) Average of Hatchability % of Nile tilapia fed different levels of hot pepper for 5th harvest during the experimental period (65 days).

Treatments	Harvest number					Total period
	1st	2nd	3rd	4th	5th	
T_1 (0.0)	78.75^{e} ±0.40	80.10^{e} ±0.40	79.75^{e} ±0.30	80.45^{e} ±0.40	80.95^{e} ±0.40	80.00± 0.29
T_2 (0.1% HP)	80.50^{c} ±0.50	80.90^{d} ±0.50	80.40^{d} ±0.50	80.65^{d} ±0.50	81.30^{c} ±0.10	80.75± 0.27
T_3 (0.2% HP)	80.95^{bc} ±0.70	82.20^{b} ±0.60	81.00^{C} ±0.40	82.45^{bc} ±0.20	80.05^{d} ±0.20	81.33± 0.32
T_4 (0.3% HP)	81.85^{b} ±0.40	81.35^{c} ±0.60	82.35^{b} ±0.40	82.75^{b} ±0.40	81.90^{b} ±0.20	82.04± 0.27
T_5 (0.4% HP)	83.45^{a} ±0.50	84.20^{a} ±0.30	84.10^{a} ±0.30	84.10^{a} ±0.30	83.35^{a} ±0.60	83.84± 0.17
T_6 (0.5% HP)	80.40^{c} ±0.60	82.10^{bc} ±0.40	82.1^{d} ±0.30	82.40^{b} ±0.50	82.60^{b} ±0.40	81.98± 0.31

- Means having the same letter in the same row are significantly different at P≤0.05

The effect of different levels of hot pepper on growth performance (body weight gain, feed consumption and feed required to produced 1000 fry) of Nile tilapia broodstock was presented in Table 6. Results showed significant effects ($p<0.05$) for fish fed different levels of hot pepper for all treatments as compared with the control group. The best treatment was T_5, which contained 0.4 % hot pepper followed by T_4, T_3, T_6, and T_2. They increased by about 23, 12, 11, 8 and 8% than control (T_1) respectively. This improvement obtained with regards to body weight gain are in agreement with researchers mentioned previously and may be due to active substances in hot pepper. Lazarevic *et al*. (2000) had indicated the active role of hot pepper compounds, specially the active compound (capscicine) and vit C that involved in stress hormones structures. These active compounds improved the immune system of birds and enhances diseases resistance through decreasing H/L ratio.

Table (6) Growth performance of Nile tilapia fed dietary hot pepper levels during the experimental period (65 days).

Item	Treatments					
	T_1	T_2	T_3	T_4	T_5	T_6
Initial weight (g)	250.0 ± 0.0	249.0 ± 0.0	249.5 ± 0.5	249.0 ± 1.0	248.5 ± 1.5	249.0 ± 1.0
Final mean weight (g)	289.5^{d} ±0.5	293.5^{c} ±0.5	295.5^{c} ±0.5	297.5^{b} ±0.5	304.0^{a} ± 2.0	299.5^{b} ±1.5
Total gain (g)	39.5^{d} ± 0.5	44.5^{c} ±0.5	46.0^{c} ± 1,0	48.5^{b} ± 0.5	55.5^{a} ± 0.5	50.5^{b} ± 0.5
Daily gain (g)	0.61^{d} ± 0.01	0.68^{c} ± 0.01	0.71^{c} ± 0.02	0.74^{b} ± 0.01	0.85^{a} ± 0.01	0.78^{b} ± 0.02
SGR % (g/day)	0.23^{e} ±0.003	0.25^{d} ±0.003	0.26^{d} ±0.006	0.27^{c} ±0.004	0.31^{a} ±0.001	0.28^{b} ±0.002
Total feed/hapa (kg)	11.78^{b}± 0.03	11.85^{ab} ±0.05	11.85^{ab} ±0.05	11.93^{a} ±0.03	11.95^{a} ±0.01	11.83^{ab} ±0.03
Feed required to produce 1000 fry, kg	0.40^{a} ±0.03	0.33^{b} ±0.02	0.29^{ab} ±00	0.28^{b} ±002	0.23^{c} ±0.003	0.29^{ab} ±0.01
The cost of feed/1000fry (LE)*	1.69^{a} ±0.11	1.39^{b} ±0.06	1.22^{ab} ±0.001	1.17^{b} ±0.01	0.97^{c} ±0.01	1.22^{ab} ±0.02

- The cost of feed/1000fry (LE) = Feed required to produce 1000 fry, kg × 4.2 (price of kg feed)
- Means having the same letter in the same row are significantly different at P≤0.05

At the end of the experiment hot pepper adding to Nile tilapia diets at level of 0.4 % was the best level than other which improved egg and fry number and these may be due to presence of active substances and vitamin C witch improved egg constitution.

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تاثير استخدام مستويات مختلفة من الفلفل الحار كإضافة غذائية على مظاهر التناسل والنمو فى البلطى النيلى

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الملخص العربى

اجريت هذه الدراسة بمفرخ خاص بمحافظة الفيوم لمدة ٦٥ يوم لدراسة تاثير خمسة مستويات مختلفة من الفلفل الحار (٠.١%،٠.٢ % ، ٠.٣% ، ٠.٤% ، ٠.٥%) بالاضافة الى مجموعة الكنترول على الكفاءة التناسلية لأسماك البلطى النيلى.

تم توزيع الأسماك التى متوسط وزنها ٢٥٠ جم وعمرها عام واحد فى١٢ هابة (٤م×٧م×١.٢م) مثبتة فى احواض ترابية بمعدل ١٢٠ سمكة فى الهابة (٩٠ انثى + ٣٠ ذكر) و تم تغذية الاسماك بالعلائق المختبرة بمعدل ٠.٦% من وزن الجسم

تم قياس خواص المياه وانتاج البيض والزريعة ونسبة الفقس ومعدل النمو وتم مقارنة الانتاج بالنسبة للعلائق ذات المستويات المختلفة من الفلفل الحار . واشارت النتائج المتحصل عليها بالنسبة للتفريخ (عدد البيض والزريعة / نسبة الفقس) ومعدل النمو الى التحسن مع زيادة نسبة الفلفل الحار من ٠.١% إلى ٠.٤% ثم إنخفض مع نسبة ٠.٥% .

ودلت النتائج ان مستوى ٠.٤% هو المستوى المناسب للعلائق بالنسبة للمستويات المختلفة من الفلفل الحار .