EFFECT OF FEEDING REGIMES ON REPRODUCTIVE PERFORMANCE OF NILE TILAPIA BROODFISH IN COMMERCIAL HATCHERIES

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ABSTRACT:

The present work was conducted in commercial hatchery at Shakshouk, El-Fayoum Governorate. The trial was started at 6/5/2005 and lasted for 122 days.

A number of 105 females and 35 males of one year old broodfish weighing 170 to 175 g in average were used per hapa. Five feeding regimes were used (0.5, 1.0, 1.5, 2.0 and 3.0% of broodfish body mass/day) forming 5 treatments (regimes). Eggs were collected at 10 day intervals starting from 28/5/2005. Data obtained were on reproductive performance, growth performance and economic evaluation.

Data revealed that the 1% feeding rate showed better reproductive performance and economic evaluation. The 0.5% feeding rate tended to show slightly lower values. The other higher levels of feeding were not recommended. To increase the number of eggs per female, hatcheries should try higher CP level in the diet and the reduction of sex ratio to 2:1 (female: male) along with a sort of broodfish selection.

Key words: Nile tilapia, broodfish, feeding rate, productive performance fecundity and economics.

INTRODUCTION:

Nile tilapia (*Oreochromis niloticus*) has rapidly became an important species for aquaculture although their intensive culture remains constrained by poor spawning synchrony and low fecundity adding significant cost to hatchery production (**Campos-Mendoza *et al.,* 2004**). In traditional systems tilapia broodfish are reared in ponds with or without supplementary feed and fry are collected from the edges of ponds. Recently, spawning of broodfish in large nylon hapas suspended in ponds has been developed (**Little *et al.*, 1995, 1997 and Bhujel *et al.*, 1998**) and became commercialized and proven to be economically viable (**Little *et al.*, 1997 and Bhujel, 1997**).

In tilapia quantity and quality of food can affect its frequency of spawning (**Hughes and Behrends, 1983; Guerrero and Guerrero, 1985; Macintosh and Little, 1995**) and the number of seed per clutch (**Guerrero and Guerrero, 1985; Rana, 1986, 1988; Macintosh and Little, 1995**). Moreover, **Izquierdo *et al.* (2001)** sited that Broodstock nutrition is one of the most important factors limiting fish fry production and larval quality. **Gunasekera *et al.* (1997)** pointed out to the critical role of nutrition to brooding females, in supplying the essential nutrients required for gonadal development as well as the performance of their seeds and larvae. **Macintosh and Little (1995)** fed brooding females at a rate of 1.5 % of the total fish biomass/day, but **Beveridge and McAndrew (2000)** used a feeding rate of 1 % of body weight/day.

As the feeding rate is one of the constraints in commercial hatcheries at Fayoum Governorate, the present work was conducted aiming to study the effect of feeding regime on performance of Nile tilapia broodfish. A simple economic evaluation was conducted.

MATERIALS AND METHODS

The present work was conducted in commercial hatchery at Shakshouk, El-Fayoum Governorate. The trial was started at 6/5/2005 and lasted for 122 days.

Five feeding regimes were used (0.5, 1.0, 1.5, 2.0 and 3.0% of broodfish body mass/day) forming five treatments (regimes).

One year old Nile tilapia (*Oreochromis niloticus*) belonging to the year 2004 generation with an average weight of 172 g ± 2.0 were stocked for spawning into ten hapas (each of 7 m length × 4 m width × 1.2 m height), two per each treatment. The distance between each treatment to another 1 m. Hapas were fixed in an earthen pond (one feddan area × 1 m depth) where 1/3 of the water level was exchanged with fresh water every 3 days. Fish were stocked at a density of 140 fish (105 female and 35 male) per hapa. Fish were fed the commercial diets containing 25.34% CP and 4.450 kcal/g GE at a rate of five regimes once daily. Fish body mass was determined at 4 week intervals and feeding rates were adjusted accordingly.

Production of seed and rate of spawning were compared with the feeding regimes.

Seeds were collected at 10 day intervals from 28/5/2005. Early in the morning, females carrying the seeds were taken from the hapa and returned after taking out the seeds. Seeds were taken to hatchery laboratory, then washed by potassium permengenate solution to prevent bacterial and fungal infection. All seeds were weighed, seed samples were taken, weighed and counted, then seeds were placed for hatching in 15 litter plastic jars, where a gentle and continuous flow of water was maintained. Broodfish were weighed at the end of the trial.

Data obtained were spawned females number/hapa, % spawned females, seed weight/hapa, seed number/hapa, seed weight/female, absolute fecundity (Rana, 1988), relative fecundity (**Campos-Mendoza *et al.,* 2004**), number of spawning/female/period, female average weight/period, broodstock weight at the start and at the end, daily gain, % SGR, feed intake and feed conversion ratio (FCR) and a simple economic evaluation.

Statistical analysis were performed using SPSS, 1997. Statistical significant between treatments was evaluated at the 5 % probability level. General liner model (ANOVA) and regression analysis were used.

RESULTS:

Water quality:

Averages of water temperature, dissolved oxygen (DO) and water pH during the experimental period are presented in Table 1.

Such data (30 ± 0.5 °C, 6.2 ± 0.1 ml DO and 8.1 ± 0.1 pH in average) were in the ranges reported by **Mironova (1977); Popma and Lovshin (1996); Ambali (1990); Watanabe *et al.* (1992); Bevis (1994); Siddiqui *et al.* (1997); Siddiqui *et al.* (1998) and Ali (2001)**.

Table (1). Water quality parameters during the experimental period.

Item	Min.	Max.	Average ± SE
Temperature	**29**	**33**	**30.55 ± 0.48**
Dissolved oxygen, ml	**5.8**	**6.5**	**6.17 ± 0.08**
pH	**7.8**	**8.2**	**8.06 ± 0.05**

Broodstock reproductive performance:

Reproductive performance parameters of Nile tilapia broodstock as affected by feeding regime is shown in Table 2.

Significant differences were found in reproductive performance of broodfish due to the tested feeding regimes. In general the lowest two feeding regimes (0.5 & 1.0% of live body weight) resulted in better reproductive performance than the other higher feeding regimes (1.5, 2.0 and 3.0% of live body weight) with Nile tilapia broodstock. Comparing the lowest two feeding regimes (0.5 & 1.0% of live body weight), both of them showed insignificant differences in seed weight and seed number/hapa/collection as well as in relative fecundity. However, the broodfish fed at a rate of 1.0% of their body weight had higher ($P \leq 0.05$) number of spawning/female/period.

Table (2). Reproductive performance per collection of Nile tilapia brood stock as affected by feeding regime.

Parameters	Feeding regime, % of live body mass					SED
	0.5	1.0	1.5	2.0	3.0	
Spawned females number per collection	13.15[b]	17.85[a]	10.85[bc]	9.30[bc]	7.70[c]	2.13
Spawned females %(1)	12.52[b]	17.00[a]	10.33[bc]	8.86[bc]	7.33[c]	2.03
Seeds weight/hapa, g	1088.0[a]	1117.5[a]	722.5[b]	605.0[b]	535.0[b]	157.29
Seed No/hapa (2)	12424.7[a]	13095.5[a]	8035.5[b]	6310.3[b]	5596[b]	1755
Seeds weight/ female, g	8.32[a]	6.16[b]	6.52[b]	6.46[b]	6.73[b]	0.54
Seed No/ female (absolute fecundity)(3)	940.7[a]	740.3[b]	714.9[b]	675.6[b]	705.4[b]	60.27
Relative fecundity(4)	5.31[a]	4.00[a]	3.45[b]	3.15[b]	3.08[b]	0.31
No of spawning/ female per period (5).	1.25[b]	1.70[a]	1.03[c]	0.89[d]	0.73[e]	0.01
Female average weight	176.75	185.3	212.35	220.40	233.9	9.76

* Average in the same row having different superscripts differ significantly P≤0.05.
* SED is the standard error of difference
* All values are averages (n=20).
* Female No/hapa = 105 female.
* No of collection = 10
(1) = Spawned females number/hapa × 100/ No of female per hapa.
(2) = Seed weight per hapa, g × Seed No per gm
(3) = (2) / Spawned females number per hapa
(4) = (3) / Female average weight per period
(5) = Spawned females number per hapa × No of collection/ Female No per hapa

Broodstock growth performance and feed utilization:

Table 3 presents growth performance and feed utilization of Nile tilapia broodstock as affected by feeding regime.

It was observed that as a level of feeding increased as Nile tilapia final weight and gain increased. However, such increases were not great specially when looking to specific growth rate (% SGR). Feed conversion showed gradual improvement as the level of feeding increased.

Table (3). Growth performance and feed utilization efficiency of Nile tilapia brood stock as affected by feeding regime.

Item (per fish)	Feeding regime, % of live body mass					SED
	0.5	1.0	1.5	2.0	3.0	
Initial mean weight, g	172.5	175.0	172.5	170.0	170.0	8.06
Final mean weight, g	180.0	192.5	257.5	275.0	317.5	8.22
Total gain, g (1)	7.5	17.5	85.0	105.0	147.5	9.35
Daily gain, g (2)	0.06	0.14	0.70	0.86	1.21	0.077
SGR, % (3)	0.034	0.077	0.328	0.395	0.512	0.037
Total feed used, g/fish	96.6	196	289.8	380.8	571.2	
Total feed used, kg/hapa	13.524	27.440	40.572	53.312	79.968	1602
FCR						
Excluding seed weight (4)	14.52^{a}	11.69^{ab}	4.81^{b}	4.20^{b}	3.86^{b}	3.09
Excluding fish weight (5)	13.06^{d}	25.21^{d}	63.42^{c}	102.63^{b}	184.53^{a}	8.15
Including fish weight and seed weight(6)	7.95^{a}	6.85^{ab}	4.69^{bc}	4.03^{bc}	3.63^{c}	1.22

* Average in the same row having different superscripts differ significantly $P \leq 0.05$.
* SED is the standard error of difference.
* period = 122 days
(1) = Final weight - Initial weight
(2) = (1) /period in days.
(3) = 100 (ln Final weight - ln Initial weight) / period in days, where ln is the natural log.
(4) = Total feed offered per hapa/ (1).
(5) = Total feed offered per hapa/ Seed weight per hapa.
(6) = Total feed offered per hapa/ (Total gain per hapa + Seed weight per hapa).
* As 70% of the produced seeds were hatched.

Table 4 shows the regression analysis between relative fecundity and broodstock body weight or feed intake.

Significant negative relationship was found between relative fecundity (RF) and broodstock body weight. Also, a negative relationship was found between RF and broodstock feed intake. This means that the increase in body weight due to the increase in feed intake reduced the relative fecundity of broodstock.

Table (4). Regression analysis between relative fecundity, RF, ($\hat{Y}$) and

either broodstock body weight, wt or feed intake, FI.

Item	$\hat{y} = a + b\,x$	r	n
wt	RF= 7.24 - 0.019 wt	- 0.537 **	20
FI	RF= 4.931 - 0.00023 FI	- 0.564 **	20

Economic evaluation of the tested feeding regimes:

Table 5 illustrates the economic evaluation of the tested feeding regimes.

The lowest two feeding regimes were more economic than the other higher feeding regimes (0.5 & 1.0% vs 1.5, 2.0 and 3.0% of body weight). Comparing the lowest feeding regimes, the 1.0% one tended to show better net returns (5.7%) than the 0.5% one. This is due to higher seed number/hapa/period.

Discussion:

The present study acts that happened in commercial hatcheries at Fayoum governorate.

Nutrition is one of the factors that can limit fish fry production (**Izquierdo *et al*., 2001). Gunasekera *et al.* (1997)** indicated that good nutrition supply the females by essential nutrients required for gonadal development as well as the performance of their seeds and larvae. **Macintosh and Little (1995)** fed their brooding females at a rate of 1.5 % of the total fish biomass/day. Therefore, in the present study feeding rates of 0.5, 1.0, 1.5, 2.0 and 3.0% of broodfish live body weight/day were tested to evaluate broodfish reproductive performance and its economics.

Table (5). Economic evaluation of the tested feeding regime.

Item	Diet % of body weight				
	0.5	1.0	1.5	2.0	3.0
Feed offered, kg	13.52	27.44	40.57	53.31	79.97
Broodfish mass at the start	24.2	24.5	24.2	23.8	23.8
Broodfish mass at the end	25.2	26.95	36.05	38.5	44.45
Seed No/hapa/period	124247	130955	80355	63103	55960
Predicted fry No	86973	91669	56249	44172	39172
Feed cost, L.E	26.37	53.51	79.12	103.96	155.94
Other costs, L.E	656.25	656.25	656.25	656.25	656.25
Total costs, L.E	682.62	709.76	735.37	760.21	812.19
Broodfish selling, L.E	226.8	242.55	360.5	385	444.50
Predicted fry selling, L.E	4348.645	4583.425	2812.425	2208.605	1958.6
Total selling price, L.E	4575.445	4825.975	3172.925	2593.605	2403.10
Net return, L.E	3,892.82	4,116.22	2,437.56	1,833.40	1,590.91
Net return relative	100	105.74	59.22	75.21	86.77
Total selling/Total costs	6.70	6.80	4.31	3.41	2.96
Total selling/Total costs relative, %	100	101.44	63.46	79.07	86.73

- Feed price 1950 L.E / ton
- Brood selling price 9 and 10 L.E for (160-200 g) and (250-500 g) respectively
- Total costs of hatchery 52500 L.E without price of diets
- The hatchery contains 80 hapa (total costs of hapa without feed = 656.25 L.E)

In the present study the reproductive performance was with the two lowest feeding rates (0.5 and 1.0% of live body weight/day) compared to the higher feeding rates tested (Table 2). The economic evaluation followed similar trend (Table 5) with better net returns with the feeding level of 1.0% of body weight. The regression analysis reflected the effect of the negative effect between relative fecundity and the feed consumed and consequently broodfish weight (Table 4). The low fecundity of broodstock of Nile tilapia was reported by **Rana (1988)**, **Baroiller and Jalabert (1989), Macintosh and Little (1995), Coward and Bromage (1998), Bhujel (2000) and Little and Hulata (2000).** In the present study broodfish of Nile tilapia that reared in net enclosures had lower fecundity or relative fecundity than that reported by **Camps-Mendoza *et al.* (2004)** and **Lu and Takeuchi (2004).** Such trend could be illustrated through different factors.

Gunasekera *et al.* (1995) tested the effect of diet protein on oocyte maturation. They indicated that the 32% protein diet seems to be adequate for tilapia broodfish. In the present study the dietary protein was 25% of the diet (commercial) focusing the attention toward increasing the level of protein in the diet to improve broodfish fecundity.

Hughes and Behrends (1983) postulated that a sex ratio of 1:2 (male:female) has been found to be better than the ratio of 1:3. In the present study the sex ratio is 1:3. So, if commercial hatcheries put such results in consideration, broodfish seeds could increase.

Also, the photoperiod, the selection of new strains broodfish, play key roles in broodfish performance. **Hughes and Behrends (1983)** found a stocking density of 5 fish/m^2 was more productive as compared to 10 fish/m^2 in hapas in tanks. Such trend was followed in the present study showing the sutable stocking density in the hatchery. **Poma and Lovshin (1996)** mentioned an increase in seed production when the rearing temperature is above 25 $^{\circ}$C up to 30 $^{\circ}$C. In the present study the temperature ranged between 29 and 33 with average value of 30.55 $^{\circ}$C (Table 1).

Conclusion:

Under the study conditions, a feeding rate of 1.0% of broodfish body weight is preferable followed by 0.5% one. Hatcheries need to test higher CP diets (32% CP or more) and reduce the sex ratio to 1:2 (male:female) along with a sort of broodfish selection. Also, the photoperiod should be considered.

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ARABIC SUMMARY:

تأثير نظام التغذية على الأداء التناسلى لأمهات البلطى النيلى فى المفرخات التجارية

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أجريت هذه الدراسة فى مفرخ تجارى بشكشوك- محافظة الفيوم بداية من ٢٠٠٥/٥/٦ واستمرت لمدة ١٢٢ يوم. استخدم فيها ١٠٥ أم و ٣٥ ذكر بلطى نيلى عمرها عام وبمتوسط وزن ١٧٠-١٧٥ جم لكل هابة (٤ × ٧ م)، استخدم خمس نظم غذائية (٠,٥، ١,٠، ١,٥، ٢,٠ و ٣,٠% من وزن الأم/يوم) مكونة ٥ معاملات. تم جمع البيض بداية من ٢٠٠٥/٥/٢٨ كل ١٠ أيام وتم الحصول على صفات الأداء التناسلى والنمو وتم عمل تقييم اقتصادى.

أظهرت النتائج أن أحسن أداء تناسلى واقتصادى كان مع معدل التغذية ١%، ٠,٥% والذى كان اقل منه بفارق طفيف مقارنة بمعدلات التغذية الأخرى العالية والتى لا يوصى بها.