JOURNAL OF THE
ARABIAN AQUACULTURE SOCIETY
Vol. 4 No 1 June 2009

An Attempt to Improve the Reproductive Efficiency of Nile Tilapia (*Oreochromis niloticus)* Brood Stock Fish Using Some Feed Additives

[1]A. M. Abdelhamid*, [1]A. I. Mehrim, [2]Manal I. El-Barbary and [1]M. A. El-Sharawy

[1]Animal Production Dept., Faculty of Agriculture, Al – Mansoura University, Egypt

[2] Aquatic Pathology Lab., National Institute of Oceanography and Fisheries, Egypt

*Corresponding Author

ABSTRACT

A field study was conducted on brood stock Nile tilapia to increase the reproduction performance. Both sexes were individually stocked into Habas (enclosures) in an earthen pond and fed for 19 days on a basal diet supplemented with different additives at graded levels of each (0.5, 1.0 and 2.0 g Therigon®; 1.0, 2.0, and 3.0 g Nuvisol Hatch P®; 20, 40 and 60 mg Gibberllic acid and 700, 900 and 1100 mg L - carnitine / Kg diet). The obtained results included that body weight of brood stock and number of ovae in ovary were studied, sexual hormones for female (FSH, LH and progesterone), and male (testosterone and gonadotropin) were measured with special references into sperm motility; after all these studies, the brood stock were evaluated and the best treatment for each sex was chosen for mating. Results indicated that all pretreatments for males and females brood stocks of Nile tilapia positively affected the total count of the offspring produced. Yet, the Haba, in which the females were pretreated with 0.5 g Therigon® / Kg diet and the males pretreated with 700 mg L – carnitine / Kg diet, gave the highest total count of the offspring comparing with the other Habas. The best economically group was at first 3rd Haba (0.5 g Therigon® / kg diet as pretreatment for ♀ only) then 5th Haba (2 g Nuvisol Hatch P® / Kg diet as pretreatment for ♀ only), followed by 4th Haba (0.5 g Therigon® and 700 mg L - carnitine / Kg diet for ♀ and ♂, respectively). It could be recommended to use such commercial feed additives for improving reproductive performance of Nile tilapia brood stocks to offer enough seeds for fish farms. It is recommend also to make other trials on different other additives at economical levels.

Keywords: Nile tilapia – Brood stock – Feed additives – Reproductive performance.

INTRODUCTION

Tilapia aquaculture is and will continue to be an important fish, particularly for the lesser-developed countries in the tropics [FAO, 2001]. Nile tilapia (*Oreochromis*

niloticus) are considered as the most common and popular fish in Egypt. Egypt, a country where, arguably, the farming of tilapia has its roots [Stickney, 2006] , where tilapia culture is believed to have originated some 4000 years ago. Tilapia consist 36% of the Egyptian production from fish culture [Sadek, 2000] and occupy the 10th order concerning the world production from aquaculture [Van Hauwaert *et al*., 2000]. Hence, Egypt produces 20% of the world tilapia capture and 12% of the world farmed tilapia [El-Sayed, 2006]. The culture of *O. niloticus* in Egypt has recently developed into a major industry. This industry, however, is still growing in a remarkable way with apparent intend towards intensification that pressurizing the need of enormous number of seeds. Many limitations associated tilapia fry production under the prevailing Egyptian conditions were described by El-Gamal [2002]. Also, brood stock husbandry and spawning techniques are constantly upgraded as Egyptian hatcheries require a high number of good quality eggs to satisfy the needs for aquaculture, so rigorous management of large numbers of brood stock are necessary for mass production of eggs and fry due to the complex reproductive biology and asynchronously spawning with relatively small number of eggs produced per spawning. Accordingly, the development of more elaborated forms of brood stock management is crucial to improve fry yield and system efficiency. Today, it is widely accepted that effective seed production demands a thorough understanding of the special husbandry and particular nutritional requirements of brood stock fish which significantly affect fecundity, survival, egg size and egg and larval quality [Bromage, 1998]. The objective of the present research was to study the possibility of improving reproductive performance of Nile tilapia fish using some feed additives, then study all the sexual parameters of brood stock and blood sera analysis of sexual hormones then detect economic efficiency of offspring.

MATERIALS AND METHODS

The present study was carried out during Nile tilapia hatching season of 2008 (June and July) in two phases, the first was to study the effects of three commercial feed

additives on females (Therigon®, Nuvisol Hatch P® and Gibberllic acid) and fourth one (L – carnitine) on males brood stock, concerning their gonads and some reproductive characteristics. The second phase was to select treatments of both 0.5 g Therigon® and 2 g Nuvisol Hatch P® / Kg diet (for females) and 700 mg L - carnitine / Kg diet (for males) to evaluate the brood stock and offspring.

Experimental management of the 1st phase

A field study was conducted in a private earthen pond fish farm located at Alabhar belonging to Alhamol, Kafr Alshiekh governorate. Fourteen Habas (each 3 m width × 6 m length × 0.5 m water depth and 1 m total depth) were constructed in a two Feddans earthen pond. The first ten Habas were stocked with females' brood stock of one year (yearlings) Nile tilapia fish (average body weight of 150 g) from the same farm. The other four Habas were stocked with males' brood stock of (the same age as the females, but of an average body weight of 200 g) Nile tilapia fish from the same farm also. Each Haba was stocked with twenty fish. The experimental feeding began on the 20th June till the 8th of July, where the feed was offered to fish twice daily, at a daily feeding rate of 3% of the fish biomass in each Haba. The feed additives were added directly to a mash diet, which all purchased from the local market (contained 90.31% dry matter, 80.88 % organic matter, 23.81% crude protein, 5.47% ether extract, and 9.43% ash) after the proximate analysis according to AOAC [2000] and moistened to be pelleted via a hand mincer. The feeding continued for males and females before mating. Water of fish rearing in each individual Haba was tested daily for some water quality parameters including water temperature, pH value, and dissolved oxygen concentration.

Dietary treatments during the 1st phase

Fish were fed on a basal ration (BR) with or without (control) the tested feed additives (Table 1) as follows:

1- Therigon® powder for veterinary use, manufactured by Adwia Co., S. A. E. 10th of Ramadan city, Egypt. Each 1 g

contains Alpha – Amino – p – hydroxyhydrocynnamic acid, 1000 g package as GnRH stimulant (Batch No. 0601116).

2- Nuvisol Hatch P®, imported by Khirat Alnile Co., 27 Alferdos Buildings, Flat 43, Nasr city, Egypt from Newtrix Co., Belgium, in 500 g package. Each 1 Kg contains the following vitamins (in mg): B_1 4000, B_2 5000, B_3 4000, B_6 2000, B_9 1000, B_{12} 20, PP 10000, Biotin 50, and L – carnitine 30000.

3- Gibberllic acid (C_{19} H_{22} O_6), type analysis, Art. 3930, M. W. 346.38, M. P. 225 °C, GA_3 content 90 %, 1 g package, Batch No. 43124, imported from Lobal Chemie, Pvt. LTD, 2042 Bombay, India.

Table1: ***Explanation of the experimental diets during the 1st phase***

Haba's No. & sex	Diets
1, ♀	Basal ration (control femeles)
2, ♀	Basal ration + 0.5 g Therigon®/ kg diet
3, ♀	Basal ration + 1.0 g Therigon®/ kg diet
4, ♀	Basal ration + 2.0 g Therigon®/ kg diet
5, ♀	Basal ration + 1 g Nuvisol Hatch P® / Kg diet
6, ♀	Basal ration + 2 g Nuvisol Hatch P® / Kg diet
7, ♀	Basal ration + 3 g Nuvisol Hatch P® / Kg diet
8, ♀	Basal ration + 20 mg Gibberllic acid / Kg diet
9, ♀	Basal ration + 40 mg Gibberllic acid / Kg diet
10,♀	Basal ration + 60 mg Gibberllic acid / Kg diet
11, ♂	Basal ration (control males)
12, ♂	Basal ration + 700 mg L - carnitine / Kg diet
13, ♂	Basal ration + 900 mg L - carnitine / Kg diet
14, ♂	Basal ration + 1100 mg L - carnitine / Kg diet

4- L – carnitine powder from Mebaco, Egypt.

Criteria measured at the end of the 1st phase

After the 19 days feeding trial of the separate sexes of brood stock, three fish from each experimental Haba were catched to collect blood, seeds (eggs), and milt for different measurements and determinations. Tri sodium citrate was used as an anticoagulant for plasma separation by centrifugation. Plasma determinations for follicle stimulating hormone (FSH), luteinizing hormone (LH) and progesterone hormone were done using commercial colorimetric kits (Diamond, Diagnostic, Egypt), and milt analyses (count, motility, forward, sluggish and dead percents) using Hämocytometer slide were done too.

Experimental management during the 2nd phase

Six Habas (similar to those used in phase one, in the same earthen pond, at the same private farm) were used in the second phase (beginning from the 9th of July) of this study. The Habas were stocked with 9 females and 3 males each (sex ratio 3 ♀: 1 ♂) to test the best treatments from phase one as following in Table 2.

The level 0.5 g Therigon® / Kg diet was chosen for its high value of FSH (Table 7), 2 g Nuvisol Hatch P® / Kg diet was chosen for

Table 2: ***Explanation of the experimental reproductive trait during the 2nd phase:***

Haba's No.	♀ × ♂from the 1st phase
1	♀fed on Basal ration (BR) × ♂ fed on BR
2	♀ fed on BR × ♂ fed on BR + 700 mg L - carnitine / Kg diet
3	♀ fed on BR + 0.5 g Therigon®/ kg diet × ♂ fed on BR
4	♀ fed on BR + 0.5 g Therigon®/ kg diet × ♂ fed on BR + 700 mg L - carnitine / Kg diet
5	♀ fed on BR +2 g Nuvisol Hatch P® / Kg diet × ♂ fed on BR
6	♀ fed on BR +2 g Nuvisol Hatch P® / Kg diet × ♂ fed on BR + 700 mg L - carnitine / Kg diet

its high value of progesterone (Table 7). On the 22nd July, the fry were collected and counted. Throughout this phase also, water quality parameters were measured daily as in phase one, at 9 – 11 am.

Statistical analysis

Data collected were statistically analyzed using SAS [9], when ANOVA-test was significant ($P \leq 0.05$), least significant difference was calculated [10] to differentiate between means**.**

RESULTS

No significant differences in all Habas were recorded in water quality parameters (Table 3) as means ± standard errors (SE), i.e. very suitable water conditions for rearing tilapia.

Data of the studied females' reproductive traits are illustrated in Table 4. Except GSI, the other tested parameters showed significant ($P \leq 0.05$) differences among treatments. The significantly heavier body weight (288.9 ± 23.8 g) after the 19 day-study was realized by the fish in the 8th Haba (20 mg gibberllic acid / Kg diet) followed by Haba No. 6 (2 g Nuvisol Hatch P® / Kg diet) without significant difference between both Habas (6 & 8). The best ($P \leq 0.05$) ovaries weight (11.5 ± 0.07 g) was recorded in fish of the 4th Haba (2 g Therigon® / Kg diet); yet, there were no significant differences among all treatments and the control. Egg number per fish (absolute fecundity) was the highest (935.5 ± 120.2 and 926.0 ± 12.7) significantly ($P \leq 0.05$) by the 5th and 3rd Habas' fish (treated with 1 g Nuvisol Hatch P® / Kg diet and 1 g Therigon® / kg diet), respectively. Yet, the egg number / Kg fish weight (relative fecundity) of these fish groups in Habas No. 5 and 3 did not differ significantly ($P \geq 0.05$)

Table 3: ***Mean ± SE values of waters quality parameters in the Habas used for rearing Nile tilapia brood stock in an earthen pond throughout the experiment.***

Item	Temperature, °C	The pH values	Dissolved Oxygen, mg / l
Mean ± SE	29.4 ± 0.19	7.50 ± 0.06	5.70 ± 0.11

Table 4: ***Females' sexual parameters of brood stock Nile tilapia as affected by the dietary supplementations for 19 days feeding trial in Habas in an earthen pond (means* ± SE).***

Haba No.	Fish weight, g	Ovaries weight, g	Egg number / fish	Egg No./Kg BW**	Egg diameter, mm	GSI***
1	178.1^{b} ± 17.1	8.45^{ab}± 1.35	769.3^{b}± 34.4	4341^{a}± 224.8	1.55^{a}± 0.12	4.71^{a}± 0.31
2	211.7^{b} ± 5.70	9.00^{ab}± 0.90	689.0^{bc}± 99.0	3267^{bcd}± 491.1	1.55^{a}± 0.12	4.26^{a}± 0.76
3	227.0^{b} ± 22.1	9.25^{ab}± 1.75	926.0^{a}± 9.00	4114^{ab}± 360.1	1.55^{a}± 0.12	4.03^{a}± 0.38
4	227.0^{b}± 32.1	11.5^{a}± 0.05	698.3^{bc}± 14.3	3037^{cde} ± 286.8	1.67^{a}± 0.00	5.14^{a}± 0.70
5	224.5^{b}± 3.50	9.00^{ab}± 1.20	935.5^{a}± 85.2	4171^{ab}± 445.0	1.25^{b}± 0.00	4.02^{a}± 0.59
6	239.0^{ab}± 19.1	10.7^{ab}± 1.75	519.0^{de}± 74.2	2161^{ef}± 138.2	0.96^{c}± 0.04	4.42^{a}± 0.38
7	223.2^{b}± 20.3	7.5^{ab}± 2.50	537.5^{d}± 12.6	2423^{def}± 163.7	1.67^{a}± 0.00	3.49^{a}± 1.44
8	288.9^{a}± 16.9	7.90^{ab}± 0.40	630.0^{bcd}± 14.1	2191^{ef}± 176.8	1.67^{a}± 0.00	3.28^{a}± 0.83
9	178.5^{b}± 4.96	5.95^{b}± 2.35	602.0^{cd}± 0.00	3376^{bc}± 93.9	1.67^{a}± 0.00	3.30^{a}± 1.22
10	223.9^{b}± 15.9	10.1^{ab}± 0.05	391.5^{e}± 12.6	1754^{f}± 68.5	1.67^{a}± 0.00	4.41^{a}± 0.40

**** Means with the same letter within the same column don't differ significantly (P ≥ 0.05).***
*****: BW=body weight.***
******: GSI = gonado – somatic index = gonads weight (g) × 100 / fish weight (g).***

with the control, which was better (P ≤ 0.05) than all the other treatments. Moreover, the lowest (P ≤ 0.05) egg diameter was reflected by the fish groups of Habas No. 6 and 5, being 0.96 ± 0.06 and 1.25 ± 0.00 mm. Otherwise, all other treatments were significantly similar to the control.

Tables 5 and 6 present data of males reproductive traits tested including testes weight and GSI as well as milt quality parameters. Although there were no significant differences among treatments and the control; yet, the control was more pronounced in fish weight, testes weight, GSI, and sperms count than the treatments. But the motility and dead percentages were better in fish group of Haba No. 12 (700 mg L - carnitine / Kg diet) followed by Haba No. 13 (900 mg L - carnitine / Kg diet) concerning motility, forward, sluggish and dead percentages.

Table 5: ***Males' gonado - somatic index of brood stock Nile tilapia as affected by the dietary supplementations for 19 days feeding trial in Habas in an earthen pond (means* ± SE).***

Haba No.	Fish weight, g	Testes weight, g	GSI**
11	283.05 ± 0.85	4.050 ± 0.05	1.425 ± 0.01
12	236.10 ± 22.3	2.350 ± 0.95	0.965 ± 0.32
13	250.00 ± 33.0	2.550 ± 0.05	1.035 ± 0.12
14	263.55 ± 14.0	2.450 ± 0.75	0.915 ± 0.24

:Means don't differ significantly (P ≥ 0.05).
****: GSI = gonado – somatic index = gonads weight (g) × 100 / fish weight (g).***

Data of plasma sexual hormones of the experimental fish are presented in Table 7. Females fish of the 3rd and 5th Habas reflected lower concentrations of (FSH) but higher concentrations of either (LH) or progesterone hormone, comparing with the other Habas' fish. This is in good accordance with the absolute fecundity which was given in Table 4. Also, male fish of the 12th and 13th Habas (Table 7) had plasma with higher levels of FSH, LH, and testosterone comparing with the other treatments. This also confirms the previous results of the milt analysis for its quality parameters (Table 6).

The following Table 8 shows that all pretreatments for males and females brood stocks of Nile tilapia positively affected propagation gave the highest total count of the offspring comparing with the other Habas. But, the 3rd, 5th, and 4th Habas were the best economically, since they were responsible for 43.5, 31.7, and 25.3 % superiority than the control (1st Haba).

Table 6: ***Data of some quality parameters of milt collected from the brood stock Nile tilapia affected by the dietary supplementations.***

Haba No.	Count, × 10^6	Motility (viability), %	Forward, %	Sluggish, %	Dead, %
11	**660**	**55**	**20**	**45**	**35**
12	**450**	**75**	**35**	**40**	**25**
13	**350**	**60**	**50**	**40**	**30**
14	**390**	**45**	**35**	**45**	**30**

Table 7: ***Data of blood plasma analysis for sexual hormones of the tested Nile tilapia brood stock fish as affected by the dietary treatments for 19 days during rearing in Habas stocked in an earthen pond.***

Haba's No. & sex	FSH(♀)/GtH1(♂), u / ml	LH(♀)/GtH2(♂), u / ml	Progesterone (♀) / testosterone (♂), ng / ml
1, ♀	32	19	0.014
2, ♀	91	18	0.110
3, ♀	13	19	0.080
4, ♀	83	61	0.060
5, ♀	14	52	0.130
6, ♀	63	48	0.140
7, ♀	16	27	0.009
8, ♀	72	84	0.006
9, ♀	14	26	0.003
10, ♀	84	28	0.017
11, ♂	48	59	2.780
12, ♂	89	76	4.310
13, ♂	78	89	5.140
14, ♂	24	38	1.010

Table 8: ***Total count of the offspring produced at the end of phase two as affected by the dietary pretreatment of the brood stock in phase one and economic efficiency.***

Haba's No.	Fry count	Fry price, LE/1000	Consumed feed price, LE	Economic efficiency	
				Absolute*	Relative
1	3400	119.0	2.44	48.77	100.0
2	3500	122.5	3.19	38.40	78.74
3	4000	140.0	2.00	70.00	143.5
4	4800	168.0	2.75	61.09	125.3
5	4000	140.0	2.18	64.22	131.7
6	4100	143.5	2.94	48.80	100.1

**** Economic efficiency = Income from buying the produced fry in LE / feed costs of the brood stock during the pretreatment in LE, where the local price of 1000 fry was 35 LE and for 1 Kg diet without additives was 2.2 LE.***

DISCUSSION

The quality of fish rearing water did not influence by the experimental treatments, and was suitable for rearing Nile tilapia brood stock according to Abdelhamid [2009]. Reproductive performance of fish is influenced by many factors, e.g. feeding regime including dietary protein [Gunasekera and Lam, 1997; Khalil *et al*., 2001 and Abdelhamid *et al*., 2003.] and vitamin [Abdelhamid *et al.*, 1999 a and b] levels, feeding rate [Abou–Zied, 2006], and hatchery management [Abou–Zied and Ali, 2007], as well as endocrine regulation [Melamed *et al.*, 1998; Daghash and Hussein, 1999; Adebayo and Fagbenro, 2004; Levavi-Sivan *et al.*, 2004 and 2006; and Sharaf 2005]. Other environmental conditions may also affect, including photoperiod and water temperature [El–Nady *et al.*, 1999; Campos – Mendoza *et al.* 2004 and Kamanga *et al.* 2004] as well as water depth [Salem *et al.*, 2005]. The fish farming industry has been more focused on the quality of eggs or larvae rather than that of sperm, even though the quality of both gametes may affect fertilization success and larval survival. Sperm quality in farmed fish may be affected by different components of brood stock husbandry, during collection and storage of sperm prior to fertilization or the fertilization procedure. Motility is most commonly used since high motility is a prerequisite for fertilization and correlates strongly with fertilization success [Rurangwa *et al.*, 2004].

Gibberellins (GAs) are involved in a wide range of plant developmental processes. Of all the plant hormones the GAs represent perhaps the most diverse group, with currently 126 different structures known [Croker and Hedden, 2001]. Gibberellins are tetracyclic diterpenes that are found in plants and fungi. A few of the identified to date are known to be active hormones that are involved in seed germination, seedling emergence, stem elongation, fertility, and flower and fruit development. The gibberellin receptor has not yet been conclusively identified. GAs act in stem growth via an enhancement of both cell division and cell elongation. Gibberellins get their unusual name from the fungus

Gibberella fujikuroi, from which they were first isolated [Sponsel, 2001]. GA_3 is naturally widespread than the other gibberellins which have sexual influences [Hifny, 1974.]. GA_3 has a pesticide effect [WHO, 1990], and also carcinogenic effect on rectal protozoon [El–Mofty, 1974] and Egyptian toads' liver [El–Mofty and Sakr, 1988]. But, Macgregor [1988] clearly demonstrated that it was essentially nontoxic by various routs of applications for different animal species.

Yet, it promotes growth of rats, poultry, pigs, and calves [Alkhaiat *et al.*, 1981 and Abdelhamid *et al.* 1993] as well as it improves laying hens' production, concerning egg production, egg mass and hatchability [Anderson *et al.*, 1982 and Abdel–Fattah *et al.*, 2007]. Gibberellins have an estrogenic effect on animals [Marasas *et al.*,1984]. It increased blood protein significantly, but affected different organs weight and their histology in chickens [Abdelhamid *et al.* 1994]. In fish, GA_3 at low levels improved Nile tilapia growth and gonado-somatic index [Abdelhamid *et al.* 1998], since it is a nitrogenous compound [Alkhaiat *et al.* 1981] with estrogenic effect; where it increased the percent of egg production, hatchability and ovary and oviduct relative weight significantly [El-Sebai *et al.*, 2003]. So using natural GA_3 instead of the synthetic estrogen is safer and environmentally friend therefore should be considered.

L–carnitine is a naturally occurring amino acid derivative (dipeptide amino acid), synthesized from methionine and lysine. L–carmitin, a betaine derivative of β –hydroxybutyrate, could be biosynthesized in plant and animal cells via lysine, methionine, and some vitamins like B_6, C, nicotinic acid and folate [Zeyner and Hameyer, 1999]. It is an essential cofactor of fatty acid metabolism (it provides energy by transporting long and medium chain fatty acids to mitochondria to act as fuel). Deficiency in carnitine is associated with male infertility. Since L–carnitine provides an energetic substrate for the spermatozoa in the epididymis, contributes directly to sperm motility and may be involved in the successful maturation of the sperm. Carnitine lowers triglycerides and raises the high

density lipoprotein levels. L–isomer of carnitine is more effective than DL – isomer [Chatzifotis *et al.,* 1995].

Cellular parameters of the seminogram have been previously shown to correlate with L–carnitine concentration in the seminal fluid. Carnitine is involved in maintaining an active oxidative phosphorylation (OXPHOS). Therefore, it was strongly suggested that relationship between carnitine secretions, seminal quality and OXPHOS activities could be because of a parallel response to the same regulatory event [Ruiz-Pesini *et al.,* 2001 and Agarwal and Said, 2004]. L–carnitine improved semen quality and histological characteristics of the testes [El-Damrawy, 2007]. Generally, a low level of L–carnitine enrichment provides several protective effects in fish reared under intensive pond-culture conditions [Schlechtriem *et al.,* 2004; Ali, 2005 and Harpaz 2005].

Pituitary homogenate induced artificially maturing and increased both serum testosterone and estradiol [Matsubara *et al.,* 2005]. Gonadotropin-releasing hormones (GnRHs) bind to the specific receptor on the gonadotrophs to activate the synthesis and release of gonadotropins (follicle stimulating hormone or FSH and luteinizing hormone or LH), which in turn control gonadal maturation, gametogenesis and gamete release [Alok *et al.,* 2000 and Hu *et al.,* 2007]. Not only do teleosts exhibit the highest variety of GnRH variants, but recent data and whole genome analyses indicate that they may also possess multiple GnRH receptor [Lethimonier *et al*., 2004]. Synthetic analog of gonadotropin-releasing hormone was used for inducing ovulation and enhancing spermiation in brood fish [Mylonas *et al*., 1995]. Moreover, territorial males of African cichlid, *Haplochromis burtoni*, characterized by aggressive and reproductive activity, have significantly larger hypothalamic gonadotropin-releasing hormone (GnRH)-containing neurons and larger testes than no territorial males [Soma *et al*., 1996].

Dietary inclusion of 1 g Nuvisol Hatch P® / Kg diet and 1 g Therigon® / kg diet before mating realized good females' reproduction performance. Also, dietary supplementation with 700 and 900

mg L-carnitine / Kg diet before mating gave better results of males' reproductive performance. But, because of the high feed cost due to the additives cost, 0.5 g Therigon® / kg diet as pretreatment for ♀ only (3rd Haba of the 2nd phase, mating), 2 g Nuvisol Hatch P® / Kg diet as pretreatment for ♀ only (5th Haba of the 2nd phase, mating), followed by 0.5 g Therigon® and 700 mg L-carnitine / Kg diet for ♀ and ♂, respectively (4th Haba of the 2nd phase, mating), respectively were the best economically.

REFERENCES

Abdel–Fattah, S.A.; N.K. Soliman, and Sh.F. Afifi, (2007). Effect of dietary cholecalciferol levels and gibberellic acid on productive and reproductive traits, serum profile and bone mineralization of laying quail. Egyptian Poultry Science, 27: 785 – 803.

Abdelhamid, A.M, F.M Khalil, and M.E.A. Mostafa, (2003). Nutritional influences on Nile tilapia *(Oreochromis niloticus)* broodstock. 4– Growth performance of fry. Proc. 2nd Inter. Conf. on Anim. Prod. & Health in Semi arid areas. Al-Arish, Egypt, pp: 645 – 654.

Abdelhamid, A.M, F.M Khalil, and M.R. Essa, (1999b). Effect of graded levels of vitamins C and/or E in diets of Nile tilapia broodstock fishes (*Oreochromis niloticus*) on: 1– Reproductive performance. Journal of Agricultural Sciences Mansoura Univ., Egypt, 24: 4655 – 4670.

Abdelhamid, A.M. (2009). Fundamentals of Fish Production and Pisciculture. New Universal Office, Alexandria, Egypt. 1st Ed., Deposit No. 24400 / 2008, I.S.B.N. 977-438-052-5.

Abdelhamid, A.M., F.M Khalil, and M.R Essa, (1999a). Effect of graded levels of vitamins C and / or E in diets of Nile tilapia broodstock fishes (*Oreochromis niloticus*) on: 1– Growth performance, chemical composition and feed utilization. Egyptian Journal of Nutrition and Feeds, 2 (Special Issue): 823 – 838.

Abdelhamid, A.M., T. M. Dorra, M.A. Ali, and El.H Abou–Egla, (1993). Effect of gibberellic acid (GA_3) -

including diets on broiler chickens. Proc. The 4th Symp. on Food Pollution, 15 – 16 Nov. Assiut, Egypt, pp: 43 – 57.

Abdelhamid, A.M., T.M. Dorra, M.A. Ali, and, El.H. Abou–Egla, (1994). Effect of gibberellic acid on broiler chickens performance and some metabolic parameters. Archives of Animal Nutrition, 46: 269 – 276.

Abdelhamid, A.M.; F.M. Khalil, and M.I. El–Barbary, (1998). Effect of using graded levels of gibberellic acid in diets differing in the crude protein levels on performance and chemical composition of Nile tilapia fingerlings. Egyptian Journal of Aquaculture and Fisheries, 2: 221 – 233.

Abou–Zied, R. M. (2006). Effect of feeding regimes on reproductive performance of Nile tilapia (*Oreochromis niloticus*) broodfish in a commercial hatchery. Fayoum. Journal of Agriculture Research and Development, 20: 242 – 249

Abou–Zied, R.M. and A.A.A. Ali, (2007). Evaluation of Nile tilapia commercial hatcheries systems in Fayoum governorate. Egyptian Journal of Aquatic Biology and Fishery, 11: 230 – 238.

Adebayo, O.T. and O.A. Fagbenro, (2004). Induced ovulation and spawning of pond raised African giant catfish, *Heterobranchus bidorsalis* by exogenous hormones. Aquaculture, 242: 229 – 236.

Agarwal, A. and T. M. Said, (2004). Carnitines and male infertility. Reproductive BioMedicine, 8: 376 – 384.

Ali, A.A. (2005). Studies on some productive traits in fish. PhD. Thesis, Fac. Agric. Moshtohor, Benha Univ., Egypt.

Alkhaiat, A.A., H. Morsy, E. Shehata, and A. Abdellatif, (1981). Veterinary Pharmacology and Toxicology. Ministry of High Education and Scientific Research. Iraq.

Alok, D., S. Hassin, R.S. Kumar, J.M. Trant, K. Yu, and Y. Zohar, (2000). Characterization of a pituitary GnRH-receptor from a perciform fish, *Morone saxatilis*: functional

expression in a fish cell line. Molecular and Cellular Endocrinology, 168: 65 – 75.

Anderson, D.L., R.D. Witkowsky, and A.M. Gawienowski, (1982). Poultry Science, 61: 1660 (cited from Abdelhamid *et al*., 1994).

AOAC (2000). Association of Official Analytical Chemists of Official Methods of Analysis. 17th Ed., Washington, DC

Bromage N, (1998). Broodstock management and the optimisation of seed supplies. Suisan Zoshoku 46, pp. 395–401.

Campos – Mendoza, A., B. J.McAndrew, K.Coward, and N.Bromage, (2004). Reproductive response of Nile tilapia (*Oreochromis niloticus*) to photoperiodic manipulation; effects on spawning periodicity, fecundity and egg size. Aquaculture, 231: 1 – 2.

Chatzifotis, S., T. Takeuchi, and T. Seikai, (1995). The effect of dietary L – carnitine on growth performance and lipid composition in red sea bream fingerlings. Fish. Sci., 61:1004 –1008.

Croker, S. J. and P. Hedden, (2001). Analysis of gibberellins. In: Tucker, G. A. and Roberts, J. A. (Eds.) Methods in Molecular Biology, vol. 141: Plant Hormone Protocols. Humana Press Inc., Totowa, New Jersey. PP: 93 – 98.

Daghash, H.A. and S.Y. Hussein, (1999). The role of gonadotropin releasing hormone (GnRH) injection on spawning, spermiation, some blood constituents and sex hormones in the African catfish, *Clarias gariepinus.* Egyptian Society for Animal Reproduction and Fertility, 11th Ann. Congr., Giza 26 – 28 Jan.,pp: 185 – 202.

Duncan, D. (1955). Multiple range and multiple F – tests. Biometrics, 11: 1 – 42.

El-Damrawy, S.Z. (2007). L - carnitine supplementation for age - induced reproductive criteria in male pigons. Journal of Agricultural Sciences, Mansoura Univ., 32: 8915 – 8929.

El-Gamal, A.A. (2002). Basic Management techniques and

reproductive performance of brood tilapia *Oreochromis niloticus* kept under recycling water systems. The 1st Annual Conference of the Egyptian Aquaculture Society. 13th - 15th Dec., Al-Arish, Egypt.

El–Mofty, M.M. (1974). Induction of sexual reproduction in *Opalina sudafricana* by injecting its host *Bufo regularis* with gibberellic acid. International Journal for Parasitology, 4: 203 – 206.

El–Mofty, M.M. and S.A. Sakr, (1988). Induction of neoplasms in the Egyptian toad *Bufo regularis* by gibberellin A_3. Oncology, 45: 61 – 64.

El–Nady, M.A., G.A. El – Naggar, M.G. Kamar, and A.I. Al – Kobaby, (1999). Effect of photoperiod, crude protein level and water temperature on reproduction performance and egg hatchability of Nile tilapia (*Oreochromis niloticus*). Bull. Fac. Agric., Cairo Univ., 50: 591 – 608.

El-Sayed, A.M. (2006). Tilapia Culture; CABI Publishing, U. K.

El-Sebai, A., M. Abaza, and S.A. Elnagar, (2003). Physiological effects of gibberellic acid (GA_3) on female Japanese quail production and reproduction. Egyptian Poultry Science, 23: 977 – 992

FAO (2001). FAO yearbook, Fishery statistics, Aquaculture production 1999. Vol 88/2.

Gunasekera, R.M. and T.J. Lam, (1997). Influence of dietary protein level on ovarian recrudescence in Nile tilapia, *Oreochromis niloticus* (L). Aquaculture, 149: 57 – 69.

Harpaz, S. (2005). L – carnitine and its attributed functions in fish culture and nutrition – a review. Aquaculture, 249: 3 – 21.

Hifny, H.A. (1974). Proceedings of the 1st meeting of the Egyptian Horticulture Society on growth regulators, Cairo, 28 Nov., 1972.

Hu, W., S. Li, B. Tang, Y. Wang, H. Lin, X. Liu, J. Zou, and Z. Zhu, (2007). Antisense for gonadotropin-releasing hormone reduces gonadotropin synthesis and gonadal development in transgenic common carp

(*Cyprinus carpio*). Aquaculture, 271: 498 – 506.

Kamanga, L. J., E. Kaunda, Mtimuni, J. P., A. O. Maluwa, and W. M. Mfitilodze, (2004). Effect of temperature on oocyte development of *Oreochromis karongae* (Trewavas, 1941). Journal of Applied Ichthyology, 20: 139 – 145.

Khalil, F.F, A.M Abdelhamid, and M.E.A Mostafa, (2001). Nutritional influences on Nile tilapia broodstock fish *(Oreochromis niloticus)*. 2– Seed production and fecundity. Egyptian Journal of Nutrition and Feeds, 4 (Special Issue): 695 – 704.

Lethimonier, C., T. Madigou, J. Muñoz-Cueto, J. Lareyre, and O. Kah, (2004). Evolutionary aspects of GnRHs, GnRH neuronal systems and GnRH receptors in teleost fish. General and Comparative Endocrinology, 135: 1 – 16.

Levavi-Sivan, B., H. Safarian, H. Rosenfeld, A. Elizur, and A. Avitan, (2004). Regulation of gonadotropin – releasing hormone (GnRH) – recepror gene expression in tilapia: effect of GnRH and dopamine. Biology of Reproduction. Society for the Study of Reproduction, Madison, USA, 70: 1545 - 1551.

Levavi-Sivan, B., J. Biran, and E. Fireman, (2006). Sex steroids are involved in the regulation of gonadotropin – releasing hormone and dopamine D_2 receptors in female tilapia pituitary. Biology of Reproduction, 75: 642 – 650.

Macgregor, R.C. (1988). In: Haresign, W. and Cole, D.J.A. (Eds.) Recent Development in Ruminant Nutrition. Butterworths.

Marasas, W.F.O.; P.E. Nelson, and T.A. Toussoun, (1984). Toxigenic Fusarium Species. Identity and Mycotoxicology. The Pennsylvania State University Press, University Park and London.

Matsubara, H., P. M. Lokman, Y. Kazeto, S. Adachi, and K.Yamauchi, (2005). Serum steroid profiles in artificially maturing female Japanese eel, *Anguilla japonica*. Aquaculture, 243: 393 – 402.

Melamed, P.; H. Rosenfeld, A. Elizur, and Z. Yaron,

(1998). Endocrine regulation of gonadotropin and growth hormone gene transcription in fish. Comparative Biochemistry and Physiology Part C: Pharmacology, Toxicology and Endocrinology 119: 325 – 338

Mylonas, C. C., Y. Tabata, R. Langer, and Y. Zohar, (1995). Preparation and evaluation of polyanhydride microspheres containing gonadotropin-releasing hormone (GnRH), for inducing ovulation and spermiation in fish. Journal of Controlled Release, 35: 23 – 34.

Ruiz-Pesini, E., E. Alvarez, J.A. Enriquez, and M.J. López-Pérez, (2001). Association between seminal plasma carnitine and sperm mitochondrial enzymatic activities. International Journal of Andrology, 24: 335 – 340.

Rurangwa, E., D.E. Kime, F. Ollevier, and J.P. Nash, (2004). The measurement of sperm motility and factors affecting sperm quality in cultured fish. Aquaculture, 234: 1 – 28.

Sadek, S. (2000). Aquaculture in Egypt: Past evaluation, present status and priorities for research to secure a sustainable development. Proc. Inter. Conf. AQUA 2000, Nice, France, May 2-6, p: 620.

Salem, M. F. I.; Mehrim, A. I. M.; and Baromh, M. Z. (2005). Effect of varying depth of water column in concrete hatching ponds on productivity of Nile tilapia brood stock. Journal of Agricultural Sciences, Mansoura Univ., Egypt, 30: 2419 – 2426.

SAS. (2001). SAS procedure user's guide. SAS Institute Inc., Cary, NC, USA.

Schlechtriem, C., V. Bresler, L. Fishelson, M. Rosenfeld, and K. Becker. (2004). Protective effects of dietary L-carnitine on tilapia hybrids (*Oreochromis niloticus* × *Oreochromis aureus*) reared under intensive pond-culture conditions. Aquaculture Nutrition, 10: 55 – 63.

Sharaf, S.M. (2005). Effect of gonadotropin – releasing gormone (GnRHs) and human chronic gonadotropin (HCG) on ovarian development and

plasma levels of sex steroids in African catfish *Clarias gariepinus*. Egyptian Journal of Applied Science, 20: 23 – 37.

Soma, K.K., R.C. Francis, J.C. Wingfield, and R.D. Fernald, (1996). Androgen regulation of hypothalamic neurons containing gonadotropin-releasing hormone in a cichlid fish: integration with social cues. Hormones and Behavior, 30: 216 – 226.

Sponsel, V.M. (2001). Gibberellins. In: Henry, H. L. and Norman, A. W. (Eds.) Encyclopedia of Hormones, Elsevier Academic Press, California, 2120 P.

Stickney, R.R. (2006). Foreword. In: El-Sayed, A.M. (author) Tilapia Culture, CABI Publishing, U.K.

Van Hauwaert, A., C. Melard, P. Verstraete, and R. Berzak, (2000). Development of a cold season diet for tilapia (*Oreochromis niloticus).* Proc. Inter. Conf. AQUA 2000, Nice, France, May 2 – 6, p: 728.

WHO (1990). Public Health Impact of Pesticides in Agriculture. WHO / UNEP, Geneva.

Zeyner, A. and J. Hameyer, (1999). Metabolic functions of L-carnitine and its effects as feed additive in horses, a review. Archives of Animal Nutrition, 52: 115 – 138.

محاولة لتحسين كفاءة تناسل أمهات أسماك البلط النيلى

عبد الحميد محمد عبد الحميد*، أحمد إسماعيل محرم*، منال إبراهيم البربرى**،
محمد عبد الفتاح الشعراوى*
* قسم إنتاج الحيوان، كلية الزراعة، جامعة المنصورة
** معمل أمراض الأسماك، المعهد القومى لعلوم البحار والمصايد،ج. م. ع.

أجريت تجربة حقلية على أمهات البلطى النيلى لزيادة كفاءتها التناسلية، فخُزنت الأسماك من كلا الجنسين منفصلين فى هابات فى حوض ترابى، وغُذيت لمدة 19 يوما على عليقة أساسية مزودة بإضافات مختلفة وبمستويات متدرجة من كل منها (0.5 – 1.0 – 2.0 جم ثيريجون، 1.0 – 2.0 – 3.0 جم نيوفيسول هاتش، 20 – 40 – 60 مجم حمض جبريليك، 700 – 900 – 1100 مجم كارنيتين/كجم عليقة). تم تقييم النتائج المتحصل عليها وذلك بدراسة أوزان الأمهات الناتجة وعددالبيض بالمبيض وقياسات الهرمونات الجنسية لكل من الإناث والذكور وقياس معدلات الحركة والنشاط للسائل المنوى وبناء على ذلك تم اختيار أفضل معاملة لكل جنس للتزاوج فيما بينها. فأشارت النتائج الى أن كل الإضافات لكلا الجنسين قد حسّنت من العدّ الكلى للزريعة الناتجة، ومع ذلك فنتائج الهابة المُغذاه إناثها على 0.5 جم ثيريجون/ كجم عليقة وذكورها على 700 مجم كارنيتين/كجم عليقة قد أظهرت أعلى معدل لإنتاج الزريعة مقارنة بباقى المعاملات، إلا أن لارتفاع سعر الإضافات الغذائية المستعملة ومن وجهة النظر الاقتصادية فإن الهابة الثالثة المعاملة إناثها فقط بـ 0.5 جم ثيريجون/ كجم عليقة، يليها الهابة الخامسة المعاملة إناثها فقط بـ 2جم نيوفيسول هاتش/كجم عليقة، يليها الهابة الرابعة المعاملة إناثها وذكورها بـ 0.5 جم ثيريجون/ كجم عليقة و 700 مجم كارنيتين/كجم عليقة على الترتيب قد أظهرت أعلى كفاءة اقتصادية.