MORPHOLOGICAL AND HISTOLOGICAL STUDIES ON HYBRID SOLE FISH *(SOLEA VULGARIS* AND *SOLEA AEGYPTIACA*)

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ABSTRACT

Sole species are important in the Egyptian waters so that fishes used in this study were collected (S*olea aegyptiaca* from Qarun Lack and *Solea vulgaris* from Bardawil Lack, Egypt. The experimental fish were transported to Shakshouk, Fayoum governorate, National Institute of Oceanography and fisheries the experiment was stocked in fiberglass tanks. The hybridization occurs bet wean females *Solea aegyptiaca* with male of *Solea vulgaris* (G1) and females *Solea vulgaris* with male *Solea aegyptiaca* (G2). Total number of fish 54 females and males from Qarun and Bardawil Lack by sex ratio 2 females: 1 male for each tank with three replicates for each treatment. These groups were injected with pituitary gland extract 4 mg/kg of body weight for two groups. The results showed comparison the two groups of length, weight brood stock, Condition factor, relative fecundity, egg diameter, fertilization rate, gonad somatic index, hatchability rate and absolute fecundity. The following measured were determined, total length, head length, trunk length, tail length and mouth opening larvae even 30 day after hatching. This study demonstrates that G2 was the best group whereas G1 was the lowest group on all performances.

Key word: Eggs, larvae, Yolk, Sole, *Solea aegyptiaca, Solea vulgaris* and hatching.

INTRODUCTION

Egyptian sole (*Solea aegyptiaca)* is the most common species of soles that contributed about 6.5% of the total catch of trawl fishery, forming about 13% of the gross revenue of the trawling (Mehanna, (2007). Kariman (2009) recorded that catch composition of sole species during summer and winter seasons in Qarun Lake were more than 50 and 35%, respectively.

The common sole (*Solea Solea*) and the Egyptian sole *(S. aegyptiaca)* are the most important sole species that endemic in the Egyptian waters. The common sole is highly appreciated fish by the Egyptians especially in the coastal communities because of its high quality flesh and is one of the commercially important fish in Egypt providing up to 90 million LE annually. Total production of *Solea aegyptiaca* and *Solea vulgaris* in Egypt 1547 ton distributed annual about Mediterranean Sea (655ton), and the lakes (Bardawil, Boroules, Qarun and Rayan) were (892) ton. The production of Solea was repressed 0.09% of total fish production in Egypt (GAFRD, 2016).

The culture potential of *S. solea* in comparison with *S. senegalensis* and pointed more information about the commercial husbandry of *S. senegalensis* (Imsland *et al*., 2003). Among the most promising candidates are solied flatfishes provide an effective culture methods and strategies for increasing market opportunities (Agulleiro *et al*., 2006).

Egg characteristics diameter of Solea was 1.0-1.60 mm, higher production of eggs and spermatozoa density was in wild-captured brood stocks egg yield (eggs/kg female) of Solea 140000-200000 (Cabrita *et al*., 2006). Whereas the optimal temperature was ranged from 8ºC to 12ºC for spawning of senegalensis but optimal temperature for gamete development was °C≈19°C for senegalensis and 12-15ºC, for solea. The better rate of fertilization success was 50-100% depended on egg and sperm quality. Also, overall incubation of egg gametes were successes by 30-80% and larvae-Juvenile Stage, larval size at hatching was ≈2.2-2.9 m for senegalensis and 4-5 mm for Solea whereas, the optimal water temperature was °C19-24°C in the first 60 days after hatching for larval development, fiberglass or concrete tanks of various sizes are suitable rearing units for *S. senegalensis* and Solea, finally the suitable time for spawning commence of Solea was through March to mid- May and while April to June was suitable for *S. senegalensis* (Imsland *et al*., 2004). The first feed of larvae begin at 3 days post hatch (Imsland *et al*., 2004). The time of spawning was controlled by photoperiod and temperature 8-12ºC, fertilization mode was natural spawning (Dinis *et al*., 2003), while Howell (1997) showed that fertilization by stripping appears not feasible. Fertilization protocol of eggs was collected in the water column by special net, the age to reach sexual maturity in the wild was 4-6 years, The optimal temperature was ranged from 18ºC to 20ºC for spawning of Solea. Bromley (2003) whereas it reach this age at 3- 4 years in captivity

Aim of study, the present work is conducted to study of morphological and histological changes of embryo and larvae produced from brood stock of *Solea aegyptiaca* and *Solea vulgaris* from Qarun Lack and Bardawil Lack.

MATERIALS AND METHODS

The present study was conducted using the research facilities of Central Laboratory for Aquaculture Research (CLAR) Abbassa and the experimental Station at Shakshouk Fayoum Governorate of National Institute of Oceanography and Fisheries (NIOF). Fishes used in this study were sole fish species, S*olea aegyptiaca* was collected from Qarun Lack and *Solea vulgaris* was collected from Bardawil Lack, Egypt. The experimental fish were transported to Shakshouk Station, by using car fish supplied by pure oxygen cylinder. Fishes were acclimatized for two week and fed on commercial diet contained (40%) crude protein. The experiment was applied in fiberglass tanks. Fish collected was divided into two groups, group one as females *Solea aegyptiaca* with male of *Solea vulgaris* (G1) and group two as females *Solea vulgaris* with male *Solea aegyptiaca* (G2). Total number of fish 54 females and males from Qarun and Bardawil Lack by sex ratio 2 females: 1 male for each tank with three replicates for each group. These group were injected with pituitary gland extract 4 mg/kg of body weight for male and female at all group. The female ovulation after 48 hour from fertilization. Morphometric measurements of 30 preserved undistorted larvae from each sample were made using an ocular micrometer on a stereo microscope. Samples of yolk-sac larvae were taken at regular intervals after hatching until the yolk reserves were almost exhausted. They were also anaesthetized and preserved in 50:50 sea water and buffered formal saline. Standard length (sl) was measured from the anterior extremity of a larva (or the tip of the upper jaw after the mouth had formed) to the posterior end of the notochord. Length of the lower jaw was measured from the tip to the angle of the mandible. Yolk sac depth (yd), width (yw) and length (yl) were the maxima for each dimension. Metamorphosis stage was evaluated on 20 larvae for each tank.

Parameter of water quality measured according to APHA (2000).

Brood stock measurements:

The following measurements were done, weight of brood stock, length of brood stock, condition factor, mg/mm3 (K, mg/ mm3) as follows: K, mg/mm3 = (W)/ (L^3) ×100 (Bagenal and Tesch (1978).

Whereas, W is total weight and L is total length.

(Bagenal and Tesch (1978). Relative fecundity is the total number of eggs per unit length or weight of female. Absolute fecundity: F= (W / w) * X

Whereas F is the absolute Fecundity, W: the weight of gonad, W: the mean weight of sub-samples and X: the counted number of mature eggs in the sub-sample. (El-Sayed, 1996).

Egg diameter: Egg diameter was measured to the nearest mm by ocular micrometer fixed in the eye piece of a light microscope.

Mean egg diameter (mm) =long axis length+ short axis length/2.

Yolk diameter: Mean Yolk diameter (mm) =long axis length+ short axis length/2.

Fertilization rate= fertilizer egg / total egg×100

Gonadosomatic index = [weight of ovary (g) / female body weight (g)] × 100.

Statistical analysis:

Results are the mean values of duplicates. SPSS 20.0 INC., Chicago, IL, USA (SPSS, 2011) was used to perform statistical calculations. All data were subjected to one-way analysis of variance (ANOVA) followed by the Duncan's post hoc multiple test at a 5% probability level Duncan, (1955).

RESULTS

Spawning and hybridization of the soles *(Solea vulgaris* and *Solea aegyptiaca)* appeared rounded and transparent fish, which are fertilized externally and float individually near the water surface, our results were be summarized in (5) Tables and illustrated in (4) Figures.

Average physic-chemical parameters of water are shown in Table (1) showed that mean values of water quality of temperature, pH, salinity (ppt), dissolved oxygen (mg/l), total ammonia (mg/l), un-ionized ammonia (mg/l), nitrite (mg/l), nitrate (mg/l), electronic conductively (mS/cm), total phosphorous (mg/dl), total soluble solids (mg/l) bicarbonate (mg/l), lead (mg/l) and nickel (mg/l) in Bardawil lake and Qarun Lake.

Table 1. Water physicochemical analysis and Heavy metals in Bardawil lake and Qarun Lake during the period of study (January - mars) (Mean ±S.E).

Item	Bardawil Lake	Qarun Lake
Temperature, °C	20.80±0.8	18.80±0.4
Ph	7.85±0.5	8.21±0.3
Salinity, ppt	37±0.9	32±0.7
Dissolved oxygen (mg/l)	6.52±0.3	6.50±0.4
Total ammonia (mg/l)	0.28±0.03	0.36±0.04
Un-ionized ammonia (mg/l)	0.011±0.001	0.014±0.001
Nitrite (mg/l)	0.112±0.002	0.126±0.001
Nitrate (mg/l)	0.42±0.03	0.48±0.01
EC (mS/cm)	35.9±0.8	37.01±0.9
Total phosphorous (mg/dl)	0.142±0.002	0.149±0.001
Total soluble solids (mg/l)	223.8±1.3	237.6±1.2
Bicarbonate (mg/l)	256.24±2.3	220.11±2.1
Lead (mg/l)	0.0017±0.0001	0.0025±0.0001
Nickel (Mg/l)	0.0041±0.0001	0.0063±0.0002

Table (2) showed that mean values (Mean ±S.E.) of brood stock weight (g), length (cm), condition factor (%) and Gonadosomatic index (%), for females and male at T1 and G2 where the highest value of female weight was noticed at G2 (58g) while the lowest value was showed in G1 (42g). The highly significant difference of length was seen in G2 (28.8cm) but the lowest significant difference recorded in G1 (26.4cm). Condition factor of females of sole under study was recorded (0.24%) in G1 and G2. Gonadosomatic index for females of the experiment were ranged between (4.12% to 4.78%) in G1 and g2 respectively. The highest value of male weight was noticed at G2 (39g) while the lowest value was reported in G1 (36g). The highly significant difference of length was recognized in G2 (27.2cm) but the lowest significant difference was recorded in G1 (26.4cm). Condition factor of males of soles under study was recorded (0.19%) at G1 and G2. The Gonadosomatic Index for male of the experiment start ranged between 2.60% to 2.81% with significant differences between two groups.

Table 2. Brood stock weight (g), length (cm), condition factor (K) and Gonadosomatic index (%), for females and male at all groups (Mean ±S.E.).

Items	G1	G2
Female		
Weight (g)	$42^{b}\pm1.21$	$58^{a}\pm0.80$
Length (cm)	$26.4^{b}\pm0.40$	$28.8^{a}\pm0.64$
Condition factor (K) (%)	$0.24^{a}\pm0.011$	$0.24^{a}\pm0.017$
Gonadosomatic index female (G.S.I) (%)	$4.12^{b}\pm0.05$	$4.78^{a}\pm0.08$
Male		
Weight (g)	$36^{b}\pm0.75$	$39^{a}\pm0.86$
Length (cm)	$26.4a^{b}\pm0.23$	$27.2^{a}\pm0.17$
Condition factor (K) (%)	$0.19^{a}\pm0.002$	$0.19^{a}\pm0.002$
Gonadosomatic index female (G.S.I) (%)	$2.60^{b}\pm0.05$	$2.81^{a}\pm0.05$

Table 3 showed that mean values of egg number, fertilized rate (%), fertilized egg number, hatchability (%), number of larvae after hatching, survival rate (%) and number of larvae after 30 day for female per first batch at treatments. The highly significant increase of egg number was recorded (1717) at G2 in the first batch while the lowest significant decrease was showed in G2 (626) in the third batch. The fertilized egg number was ranged between 1374 to 488 for G2 in first batch and G1 in third batch. Fertilized rate were significant increase in G2 (80%) at batches (1, 2 and3), but the lowest value was showed in G1 (78%) at three batches. In the same table the highest value of number larvae after hatching was noticed at G2 (1058) in the first batch, but the lowest value was showed at G1 (415) in third batch. Hatchability rate was ranged between 85% to 88% for G1and G2 respectively with significant differences between treatments at three batches. The highest value number of larvae after 30 day was noticed at G2 (302) in the first batch, but the lowest value was noticed at G1 (91). The survival rate of larvae after 30 day was recorded 22% and 25% at G2and G1 in the three batches. Absolute fecundity was 25497%, 9469%, 12512 % and 21467% in (G1, G2, G3 and G4) respectively with significant differences between all treatments. The highest values were 25497% for G1 and the lowest value was 9469% at G2. Relative fecundity for weight was 398.39%, 263.02%, 278.04% and 370.12% for (G1, G2, G3 and G4) respectively with significant differences between all treatments. Relative fecundity for length was 858.48%, 367.01%, 473.93% and 745.38% at G1, G2, G3 and G4 respectively with significant differences between all treatments. The highest values of relative fecundity for length were (858.48%) and the lowest value were (367.01%).

Table 3. Mean ±S.E. reproductive performances of hybrid sole fish (*Solea vulgaris* and *Solea aegyptiaca*).

Items	G1			G2		
	Batch1	Batch2	Batch3	Batch1	Batch2	Batch3
Egg number	$1001^{d}\pm$ 25.055	$876^{e}\pm$ 43.878	$626^{f}\pm$ 24.826	$1717^{a}\pm$ 57.735	$1503^{b}\pm$ 34.641	$1073^{c}\pm$ 33.486
No. Fertilized egg	$781^{d}\pm$ 69.282	$683^{e}\pm$ 69.282	$488^{f}\pm$ 49.074	$1374^{a}\pm$ 54.848	$1202^{b}\pm$ 54.848	$858^{c}\pm$ 45.033
Fertilized rate (%)	$78^{b}\pm$ 0.288	$78^{b}\pm$ 0.288	$78^{b}\pm$ 0.288	$80^{a}\pm$ 0.577	$80^{a}\pm$ 0.577	$80^{a}\pm$ 0.577
No. of larvae after hatching	$664^{d}\pm$ 35.055	$581^{e}\pm$ 41.569	$415^{f}\pm$ 39.259	$1209^{a}\pm$ 43.301	$1058^{b}\pm$ 23.094	$755^{c}\pm$ 30.599
Hatching rate (%)	$85^{b}\pm$ 0.577	$85^{b}\pm$ 0.577	$85^{b}\pm$ 0.866	$88^{a}\pm$ 0.288	$88^{a}\pm$ 0.288	$88^{a}\pm$ 0.288
No. of larvae after 30 day	$146^{d}\pm$ 10.433	$128^{e}\pm$ 8.660	$91^{f}\pm$ 11.547	$302^{a}\pm$ 17.320	$265^{b}\pm$ 14.433	$189^{c}\pm$ 5.773
Survival rate (%)	$22^{b}\pm$ 0.577	$22^{b}\pm$ 0.577	$22^{b}\pm$ 0.577	$25^{a}\pm$ 0.577	$25^{a}\pm$ 0.577	$25^{a}\pm$ 0.577
Absolute fecundity (%)		$12512^{b}\pm$ 467.65			$21467^{a}\pm$ 594.6	
Relative fecundity for weight (%)		$278.04^{b}\pm$ 4.04			$370.12^{a}\pm$ 4.61	
Relative fecundity for length (%)		$473.93^{b}\pm$ 16.16			$745.38^{a}\pm$ 19.62	

In Table (4). The results of eye diameter (mm) and the distance between eyes from hatching date up to 30 days after hatching during rearing period under laboratory conditions at all treatments. The embryo in 1st day was significant increased (0.22 mm at G2 and 0.21 mm at G1). The 30 day of developing eye diameter (complete metamorphosis) the results show that there was significantly difference increased during the experimental period eye diameter was 0.55 mm and 0.61 mm in G2 and G1 respectively. The distance between eyes at 15 days after hatching were significant decrease at G1 (0.28 mm), whereas significant increase at G2 (0.33 mm). In twenty days G1 and G2 were recorded this values 0.27 mm and 0.31 mm respectively with significant differences between groups. The twenty sex days the highest value was showed at G2 (0.27 mm), but the lowest value was showed at G1 (0.25 mm), with significant differences between groups. In thirteen days the highest value was showed at G2 (0.26 mm), the lowest value was recorded at G1 (0.25 mm) with non-significant differences between all groups.

Results revealed that the mouth opening of fries at fourth day were ranged from 0.13 mm to 0.15 mm at G1 and G2 respectively with significant differences between tested groups. In thirty days of mouth opening ranged from 0.70 mm to 0.74 mm at G1 and G2, respectively.

Table 4. Mean ±S.E. of eye diameter (mm) and the distance between eyes from hatching date up to 30 days after hatching.

Items	G1	G2
	Eye diameter (mm)	
1st day	0.21^{b}±0.002	0.22^{a}±0.004
30 day	0.55^{b}±0.011	0. 61^{a}±0.005
	Distance between eyes	
15 day	0.28^{b}±0.005	0.33^{a}±0.005
20 day	0.27^{b}±0.011	0.31^{a}±0.005
26 day	0.25^{b}±0.004	0.27^{a}±0.005
30 day	0.25^{b}±0.005	0.26^{a}±0.004
	Mouth opening (mm)	
4 day	0.13^{b}±0.003	0.15^{a}±0.001
30 day	0.70^{b}±0.011	0.74^{a}±0.005

The results referred in Table (5) showed that mean values of total length (mm), head length (mm), trunk length (mm) and tail length from hatching date up to 30 days after hatching during rearing period under laboratory conditions for all groups. Total length for first day stage was ranged from 1.66 mm to 2.01 mm in G1 and G2 respectively. The highest value in thirty day for total length was recorded at G2 (11.09 mm) whereas the lowest value was noticed at G1 (9.35 mm). The 1st day stage from head length (mm) was ranged from 0.31 mm to 0.35 mm at G1 and G2 respectively. Whereas the highest value in 30 day stage for head length was recorded in G2 (2.85 mm) whereas the lowest value was noticed in G1 (2.38 mm). The trunk length (mm) of the tested larvae in 1st day the highest value was recorded at G2 (1.00 mm) whereas, the lowest value was showed at G1 (0.75 mm). In the same table the thirty days was recorded significant increased in G2 (5.28 mm) whereas G1 was recoded (4.28 mm). The tail length (mm) of the tested larvae in 1st day the highest value was recorded at G2 (0.66 mm) whereas the lowest value was showed at G1 (0.60 mm). Whereas; at thirty days was recorded significant increased in G2 (2.96 mm) but tail length was significant decrease at G1 (2.69 mm).

Table 5. Total length (mm), head length, trunk length and tail length from hatching date up to 30 days after hatching groups (Mean ±S.E.).

Items	G1	G2
	Total length	
1st day	$1.66^{b}\pm0.05$	$2.01^{a}\pm0.11$
30 day	$9.35^{b}\pm0.51$	$11.09^{a}\pm0.46$
	Head length	
1st day	$1.66^{b}\pm0.05$	$2.01^{a}\pm0.11$
30 day	$9.35^{b}\pm0.51$	$11.09^{a}\pm0.46$
	Trunk length	
1st day	$0.75^{b}\pm0.086$	$1.00^{a}\pm0.017$
30 day	$4.28^{b}\pm0.230$	$5.28^{a}\pm0.173$
	Tail length	
1st day	$0.60^{b}\pm0.011$	$0.66^{a}\pm0.017$
30 day	$2.69^{b}\pm0.057$	$2.96^{a}\pm0.057$

Histology of sole larval development:

To illustrate the effect of different periods on hybrid sole larval development organs at first, second, third and fourth week. The histological structure of eye, buccal cavity, intestine, gills and liver were investigated as shown in Table (6) and Figures (1, 2, 3 and 4).

Table 6. Lesion score of fish larval development organs for different periods.

Items	G1				G2			
Organs	First week	Second week	Third week	Fourth week	First week	Second week	Third week	Fourth week
Eye	++	++	++	+++	++	++	+++	+++
Buccal Cavity (mouth)	+	++	++	+++	+	++	+++	+++
Intestine	0	++	++	+++	0	++	++	+++
Gills	+	++	++	+++	+	++	+++	+++
Liver	0	+	+	+++	0	+	+	+++

Lesion score designed as (0=Not presence, +=Developed, ++=Well developed, +++=Very well developed).

G1 G2

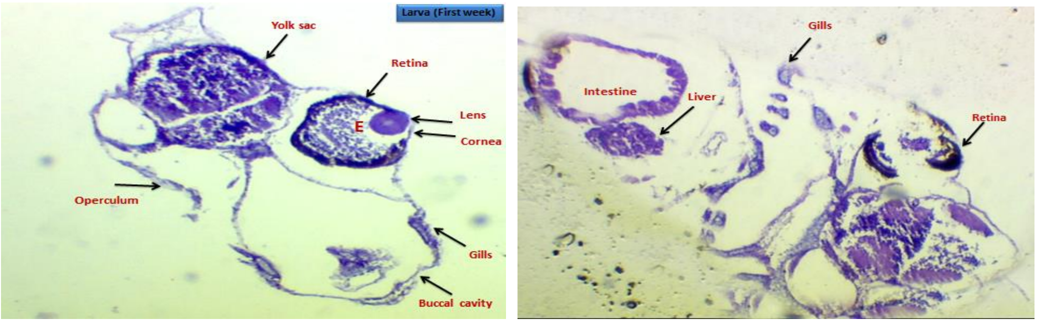

Fig. 1. Representative photomicrograph of the fish larva (First week) showing well developed eye and interior parts with operculum and yolk sac. H&E stain X 100 and 400.

G1 G2

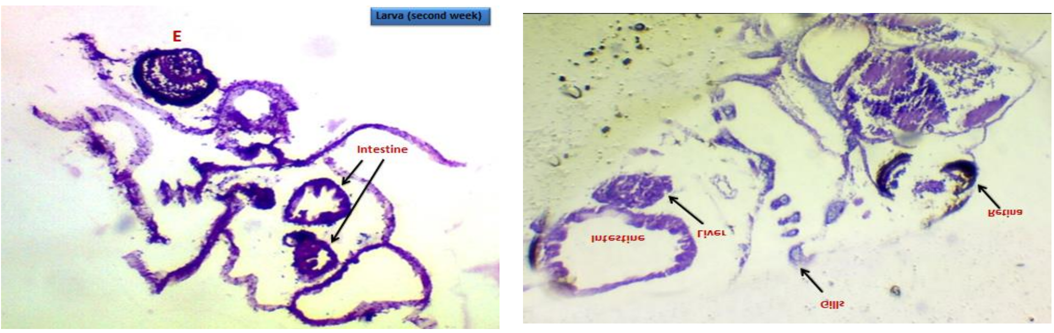

Fig. 2. Representative photomicrograph of the fish larva (Second week) showing A) well developed eye and presence of intestine. B) well developed eye (retina only), appear of each intestine, liver and rudimentary gills. H&E stain X 100 and 400.

G1 G2

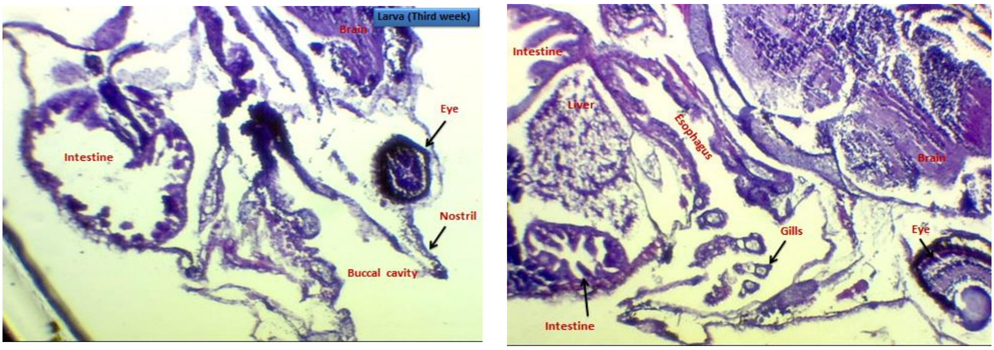

Fig. 3. Representative photomicrograph of the hybrid sole larvae (Third week) showing A) well-developed of each eye, buccal cavity and intestine. B) Marked gills and esophagus beside liver, intestine and intestine (contain villi), well-developed eye followed brain. H&E stain X 200.

G1 G2

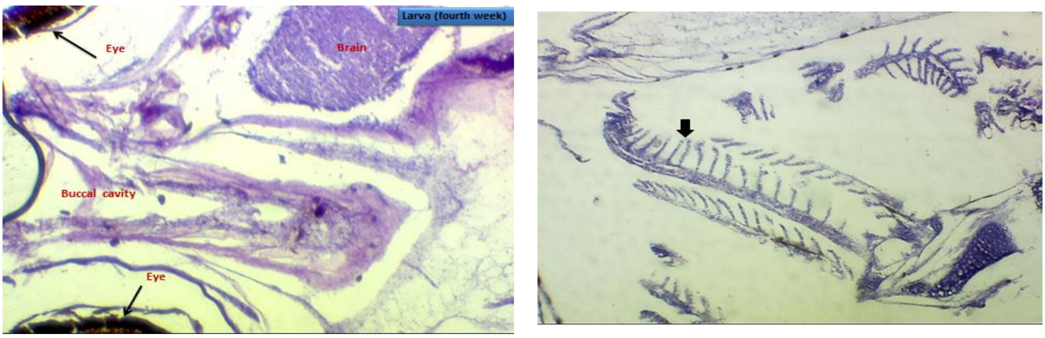

Fig. 4. Representative photomicrograph of the fish larva (Fourth week) showing well developed eye and buccal cavity with tongue followed by brain. B) Well-developed gills including gill rakers, arches and primary and secondary lamellae are prominent. C) Well developed intestine with marked intestinal villi beside hepatic tissue. H&E stain X 100 and 400.

DISCUSSION

Broodstock productivity clearly represents the most significant constraint on commercial fish production. Increased knowledge of the factors regulating broodstock productivity is therefore of great importance to the further development of *Solea aegyptiaca* culture. Hormonal induction of ovulation for S*olea aegyptiaca* and *Solea vulgaris* were successful with pituitary gland extract in the present study, artificial spawning achieved. In similar studies, Assem *et al.* (2012) showed that, artificial spawning of *Solea vulgaris* were achieved using carp pituitary extract (CPE) from 40- 70 µg/fish (equal to 200 µg/ Kg fish) or HCG from 2300 to 3000 IU/fish (equal to 10000 IU/ Kg fish) as a priming dose, followed by luteinizing and releasing hormone nalogue (LHRHa) from 52- 60 µg/fish (equal to 200 µg/ Kg fish) in the resolving dose.

Although the act of egg release could not be seen on the recordings, the behavior observed was almost certainly associated with spawning and was similar to that described by Horwood, (1993). The GSI reflects the physiological activity of the gonads, where an increase is an indication of the beginning of the breeding season of the fish. Generally, males' GSI of *S. vulgaris* and *S. aegyptiaca* in the Gulf of Gabes was lower than females.

In Port Said (Egypt), the spawning season has been reported by Ahmed *et al*. (2010) as January to June. El-Husseiny (2001) reported that the GSI of female *S. aegyptiaca*, in Lake Qarun, increased progressively to reach its maximum value in January, while the minimum value was recorded in July. Teixeira and Cabral (2010) found that the spawning period of both *S. Solea* and *Solea senegalensis* occurring in sympatric along the Portuguese coast is in winter.

production of eggs are mainly depended on female weight and female preparing for spawning by many conditions such as feeding, stimulating hormones, water temperature, water salinity and good health of males with good preparing before spawning season. In this study we showed that egg number and other egg character are mainly affected by weight and previous conditions. The ripe eggs of *Solea aegyptiaca* appeared rounded, colorless and transparent. The surface of the fertilized egg shell is smooth, the fertilized egg appeared rounded. Many authors were in agreement with this description of the present study Assem *et al.* (2012), for *Solea vulgaris* and *Solea Solea*. In this study, the ripe and fertile eggs of *Solea aegyptiaca* was about 0.99 and 0.93 mm in diameter, respectively and newly hatched larvae were about 1.42 mm in length. Egg characteristics diameter of Solea was 1.0-1.60 mm. higher production of eggs and spermatozoa density was in wild-captured brood stocks. Egg yield (eggs/kg female) of Solea 140000-200000 (Imsland *et al.*, 2004). Optimal temperature for gamete development was °C≈19°C for *Senegalese Solea* and 12-15ºC, for Solea. Assem *et al.* (2012) recorded that, the ripe and fertile eggs of *Solea vulgaris* was about 1.04 and 1.2 mm in diameter, respectively and newly hatched larvae was about 1.8 mm in length. Also Herrera *et al.* (2008) mention that, the newly hatched wedge sole larvae were 2.34 mm in length. Moreover, Jimenez *et al.* (2001) reported that, the newly hatched wedge sole larvae total length in wild was 1.57 mm. This value is smaller to that recorded in captivity (2.39 mm). This fact may be related to the large size of the captive breeders, as they were bigger than those found in the wild (Assem *et al.*, 2012). In the present study, hatching of *Solea aegyptiaca* eggs occurred after 48±3 h from fertilization at temperature 17-19 ºC, while occurred after 60-72 h from fertilization at temperature 14-16 ºC.

Larvae contribute to that success in reaching the juvenile stage. Specifically, the Senegal sole showed an early functionality of the mouth and the digestive tract (Sarasquete *et al.* 2001) and an excellent efficiency at initial feeding. Studied the broodstock management and larval rearing of *Solea senegalensis* and concluded that after 7 months in captivity a wild broodstock spawned naturally at temperature ranging from 16.5±0.5 °C to 22±1.0 °C and salinity from 30 to 35 ppt. Egg with 100% fertilization presented viability ranging from 90% to 100%

These processes can affect energy expenditure and consequently fish condition (O'Neill *et al.*, 2011). Growth performance in addition, sole fish usually lives on sandy and muddy seabed. They mainly hunt for feed at night and feed on worms, mollusks, small fishes and crustaceans (Picton and Morrow, 2010).

Classification into developmental stages is a more accurate method to determine and standardize larval development than other criteria frequently used, such as the age from hatching (dph) or larval size, because it is independent of the rearing conditions and the water-rearing temperatures. Staging larval development using morphological characters is of special value when dealing with fish species with a great range of size Gisbert *et al.*, (2002), *S. aegyptiaca* and *S. vulgaris* is not an exception. In addition, hatching time was not synchronous for larvae used in this study and, consequently, their rate of development also varied. Considering these results, *S. aegyptiaca* and *S. vulgaris* larvae follow similar developmental patterns of other flatfish species and small marine pelagic fish larvae. It should be stressed, however, that in *S. senegalensis* the endogenous feeding period (lecithotrophic stage) is shorter (*c.* 60° D) than in most flatfish and marine species with small pelagic eggs (*c.* 90° D) (Falk-Petersen, 2005). Although general patterns of development in *S. aegyptiaca* and *S. vulgaris* seem to be similar to most marine fish larvae already described, this study presents data on specific developmental characteristics in *S. aegyptiaca* and *S. vulgaris* which are probably derived from the species' particular environment (subtropical waters) and behavior (nocturnal, benthic, omnivorous fishes). In fact, there seems to be a wide variation among flatfish species in the timing, order and synchronicity of the different organ and system changes, which may explain the species-specific differences in the extent of growth and feeding during larval development, metamorphosis and settlement (Geffen *et al.*, 2007).

CONCLUSION

Solea Solea is an economic fish but they are not common in fish farms in Egypt. There are two species in Egypt, *Solea aegyptiaca*, live in Qarun Lake and *Solea vulgaris* live in Bardawil Lake, so this study concluded that:

1- Inducing of male and female by injecting carp pituitary extract give good results for spawning.

2- Growth rates of larvae were better in G2, this may due to the large size of *S. vulgaris* females.

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دراسات مورفولوجية وهستولوجيةعلى هجين اسماك موسى سوليا فولجاريس وسوليا اجيبتياكا

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الملخــــص العربـــى

الاسماك المستخدمة فى هذة الدراسة اسماك موسى سوليا اجيبتياكا من بحيرة قارون وسوليا فولجاريس من بحيرة البردويل. الاسماك المستخدمة فى التجربة نقلت الى محطة معهد علوم البحار والمصايد شكشوك محافظة الفيوم بواسطة سيارة نقل الاسماك المزودة باسطوانة اكسوجين نقى. تم اقلمة الاسماك لمدة اسبوعين وتم تغذيتها على عليقة تجارية (٤٠%) بروتين. تم تخزين اسماك التجربة فى احواض فيبر جلاس. التجربة وزعت اناث سوليا اجيبتياكا مع ذكور سوليا فولجاريس واناث سوليا فولجاريس مع ذكور سوليا ايجيبتياكا. اجمالى عدد الاسماك ٥٤ اناث مع ١٨ ذكور من بحيرة قارون وبحيرة البردويل. وكانت النسبة الجنسية ٢ اناث الى ١ ذكور فى كل تانك. وكانت لكل معاملة ٣ مكررات. وهذة المعاملات حقنت بمستخلص الغدة النخامية ٤ ملى جرام لكل كجم وزن حى. القياسات الظاهرية لعينة ٣٠ يرقة محفوظة غير مشوهة تمت تحت ميكرسكوب ضوئي. وقياسات الخصوبة دليل المناسل ونسبةالاخصاب ونسبة الفقس الطول الكلى وطول كلا من الرأس والجذع والزيل على اليرقات حتى ٣٠ يوم. تم قياس الطول القياسى من مقدمة اليرقة (من مقدمة الفك العلوي بعد اكتمال فتحة الفم) وحتى النهاية الخلفية من الحبل الظهرى.

اهم النتائج : كانت المجموعة الثانية هى افضل من المجموعة الاولى فى جميع القياسات.