Study of embryonic development and evolution stages of Yellow fin sea bream (*Acanthopagrus latus*).

Gholamhossein Mohammadi[1], Mojgan Khodadadi[2]

[1.]South of Iran Aquaculture Research center, gmohammady@gmail.com
[2.]Department of fisheries, Islamic Azad University, Ahvaz Branch, Ahvaz, Iran

Abstract: In present survey development and evolution stages of Yellow fin sea bream (*Acanthopagrus latus*) fetus in two averages temperature 21 and 24 centigrade degree were studied. The brooders were collected from fishery grounds of south of Persian Gulf. Average diameter of lipid globule was 185±0.005 micron and eggs diameter after fertilization were 740.33±0.012. Length of newly birth larvae was 1679.34 microns. Incubation period in 24 ˚C was 26 hours and 15 minutes. During the incubation 2-cells stage was observed at 20 minutes. Embryonic evolution stages were distinguished in these study as follows: 1: Two-Cells Blastomere, 2 four -Cells Blastomere, 3: eight - Cells Blastomere, 4: sixteen - Cells Blastomere, 5: Thirty two -Cells Blastomer, 6: Morula, 7: High Blastula Stage 8: Flat Blastula Stage, 9: Starting of Gastrulation, 10: Gastrulation, 11: Neurula, 12: Observation Embryo Profile, 13: Closing of blastopore, 14: The Formation of Somite, 15: The Appearance of Heart, 16: The Formation of Optic Cup, 17: Increasing of Pigmentation, 18: Hatching (10%), 19: Hatching (100%).
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Key worlds: Yellow fin sea bream, *Acanthopagrus latus*, fetus, evolution, Incubation, Persian Gulf

1. Introduction

The porgies (Percoidei: Sparidae) are primarily coastal fishes with about 110 species and 33 genera. Smith (1938) and Smith and Smith (1986) placed the genera of Sparidae in four subfamilies (Boopsinae, Denticinae, Pagellinae, and Sparinae) based primarilyon dentition.

The Sparidae is a predominantly marine family, which is found in the Indian, Pacific and Atlantic oceans (Nelson, 1994) and contains many species of commercial and/or recreational importance and some that are used for aquaculture (e.g. Foscarini, 1988; Kailola *et al*., 1993; Ingram *et al.*, 2002).

The yellow fin sea bream, *Acanthopagrus latus* (Hottuyn), is one of the important Species commercially exploited in Kuwait. In view of its economic importance, Popularity with consumers and increased rate of exploitation (Al-Kanaan, 1999).

A. latus is a protandrous hermaphrodite (Kinoshita,1939; Abol-Munaf &

Umeda, 1994; Abu-Hakima, 1984; Abou-Seedo *et al*. inpress) although nearly Half (51.7%) of the individuals with in a generation is dioecious, out of which22.9% are females (Abou-Seedo *et al*.2003).

Various studies have been conducted on the properties and the development of sea bream eggs. It was reported that survival rate predominantly depended on egg size and eggs obtained by hormonal treatment were relatively smaller in size (Boulineau, 1974; Nash and Kuo, 1975). Feeding of the broodstock under favourable conditions has a major impact on the quality of egg (Bromage and Roberts, 1995). It was also reported that an increase of 2-3‰ in salinity during incubation would be risky (Freddi, 1985).

The main factor affecting the rate and the quality of the embryonic development is temperature. Going beyond optimal limits during incubation leads to the deterioration of the cellular symmetry and the breaking of the oil globule; it also causes mass mortality and consequently a drop in the rate of larvae production during gastrulation (Jennings and Pawson, 1991). In this study, cleavage and embryonic phase of 18.5°C, which is accepted as the optimal limit of temperature for incubation, have been investigated**.**

2. Materials and methods

Yellow fin sea bream brood stock, 3 females and 3 males, were selected from wild breeders and stocked in two 10 m3 tank with a seawater flow of 1.5 m3 per h. Frozen cuttlefish (*Sepia officialis*) and small trash fish food source, were provided daily. No hormonal treatment was applied to the breeders and spawning occurred spontaneously. Eggs were incubated in 30-l dark covered incubators at an initial density of 50eggs/l, with a gentle flow of 22 ± 0.2 ¼C seawater. Oxygen was 6.5 – 7.8 mg/l, salinity was 42 ppt, and pH was approximately 8.2. Photographs were taken from samples using strio microscope. Diameter of the egg and oil globule, fetus diameter, fetus length, eye size, larve length, larve yolk sack length was measured using Bicocom@Visolob soft wear. To determine the common embryonic developments, 100 eggs were taken from each incubator and were determined every 5 min until the blastomere (32 cells)

stage and then at 45 minutes intervals. Samples fixed in formaline 1%.

Results:

Yellow fin sea bream fertilized eggs are buoyant, transparent, and typical of sparid fish. Fertilized eggs were had a blastomer cell and in this stage circular blastomer was observed in animal polar.

During the incubation, the salinity of natural seawater was 36.3-37.4‰. The oxygen levels ranged between 6.5 and 7.8 mg/l. Fertilized eggs ranged in diameter from 735.9 to 787.2 µm with a mean of 740.33 ± 0.0112 µm eggs containing a single unpigmented oil globule were positively buoyant (Figure 1-1A). Oil average globules 0.185 ± 0.005 µm to diameter. Incubation period in 24 °C was 26 hours and 15 minutes.

During the incubation 2-cells stage was observed at 20 minutes.

Photographs of all stages are presented in Figures (1 and 2 gropes).

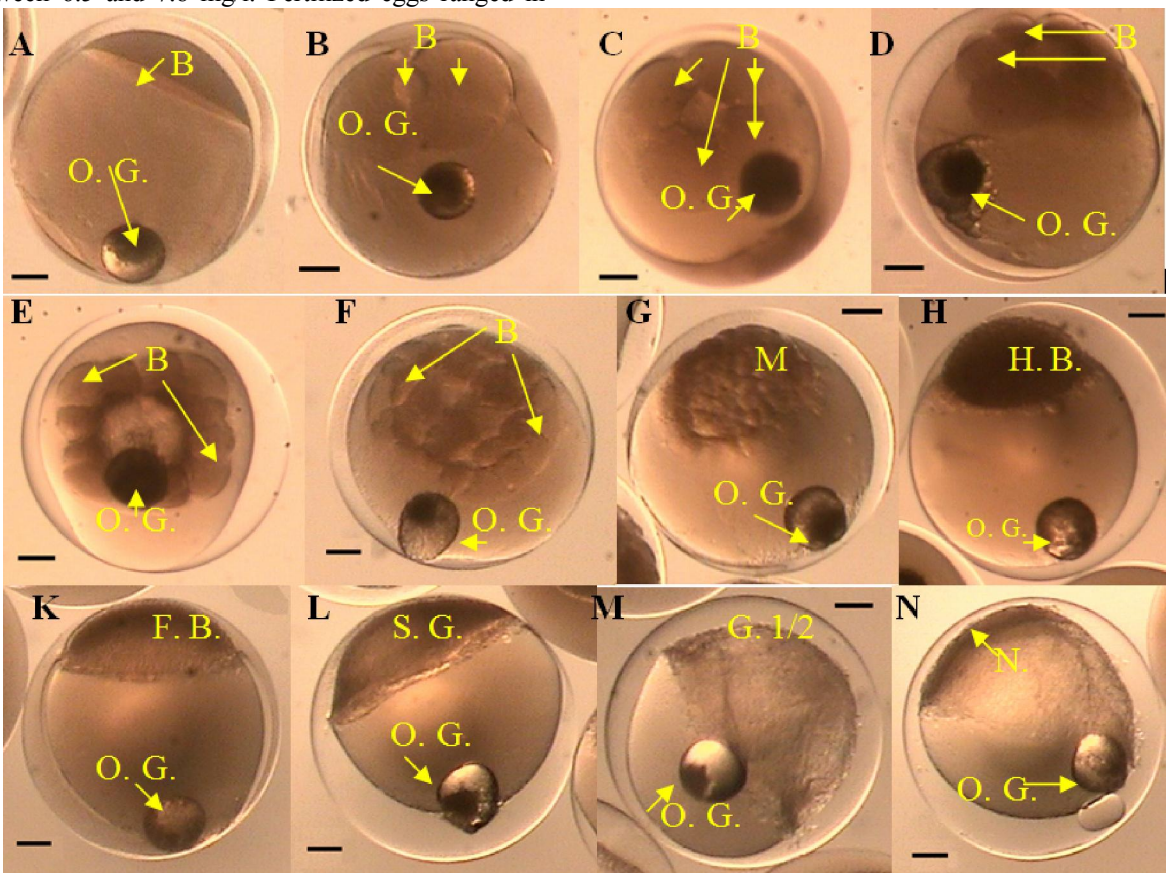

Fig.1 (A to N): Yellow fin sea bream embryonic stages, left to right A: fertilized egg; B: 2-cell blastomere; C: 4 – cell blastomere; D: 8– cell blastomere; E: 16- cell blastomere; F: 32- cell blastomere;G: Morulla; H: Early Blastula; K: Late Blastula; L: Early gastrula; M: Gastrulation 1/2; N: Neurula. (Abbreviations, B: Blastomer, O.G.: Oil Globule, M: Morulla, H. B.: High Blastula, F. B.: Flat Blastula, S. G.: Starting of Gasterulation, G1/2: Gasterulation 1/2, N: Notochord)

We distinguished 19 developmental stages for preserved snapper eggs from spawning to hatching as follow.

This is the first stage after fertilization (Figure: 1-A) and zygote have a blastomere cell. The blastomere is completely circular in animal pole.

2_cell Belastomeres: by the time the first cell division stage appeared to be (Figure: 1-B) this step will create a furrow in the cell and spread toward the edges of the Blastodisk and this time the egg is a two-cell blastomeres. Blastomeres at this stage are almost spherical and transparent.

4- cell blastomeres: the eggs contain four similar cell blastomeres. In this stage, the blatomeres lost their spherical shape and form to be drawn (Figure: 1-C).

8- cell blastomeres: In these stage the eggs contain eight cells care in two rows of are arranged together in a foursome. The blastomeres at this stage are similar to each other (Figure: 1-D).

16- cell blastomeres: The egg is a sixteen-cell blastomeres at the four rows of four have been together wand. Sixteen-cell stage blastomeres have different outward forms (Figure: 1-E).

32- cell blastomeres: The eggs is a thirty-two-cell blastomeres. Unlike in the earlier stages, blastomeres are not regularly together (Figure: 1-f).

Morulla: solid mass of blastomeres resulting from a number of cleavages of a zygote, or fertilized egg. Its name derives from its resemblance to a mulberry (Latin: *morum*). A morula is usually produced in those species the eggs of which contain little yolk and, consequently, undergo complete cleavage (Figure: 1-G).

Early Blastula Stage: In eggs of yellow fin sea bream, blastula stage, blastomeres form a cell layer that is transparent and colorless in the animal pole and the yolk to form a hollow sphere or hemisphere can be observed (Figure: 1-H).

Late Blastula Stage: At this stage of embryonic development of yellow fin sea bream, height and thickness of the reduced cell mass and its size will increase. At this stage, a layer of embryonic (Epiboly) in animal cells is formed and develops as a pod and the blastopore grow (Figure: 1-K). Unlike the previous steps in this phase, cell division (consequently fetal growth layer) is more uniform. Mitotic divisions because of the inconsistency phenomenon that does not happen in a short timeframe (Kimmel *et al*., 1995).

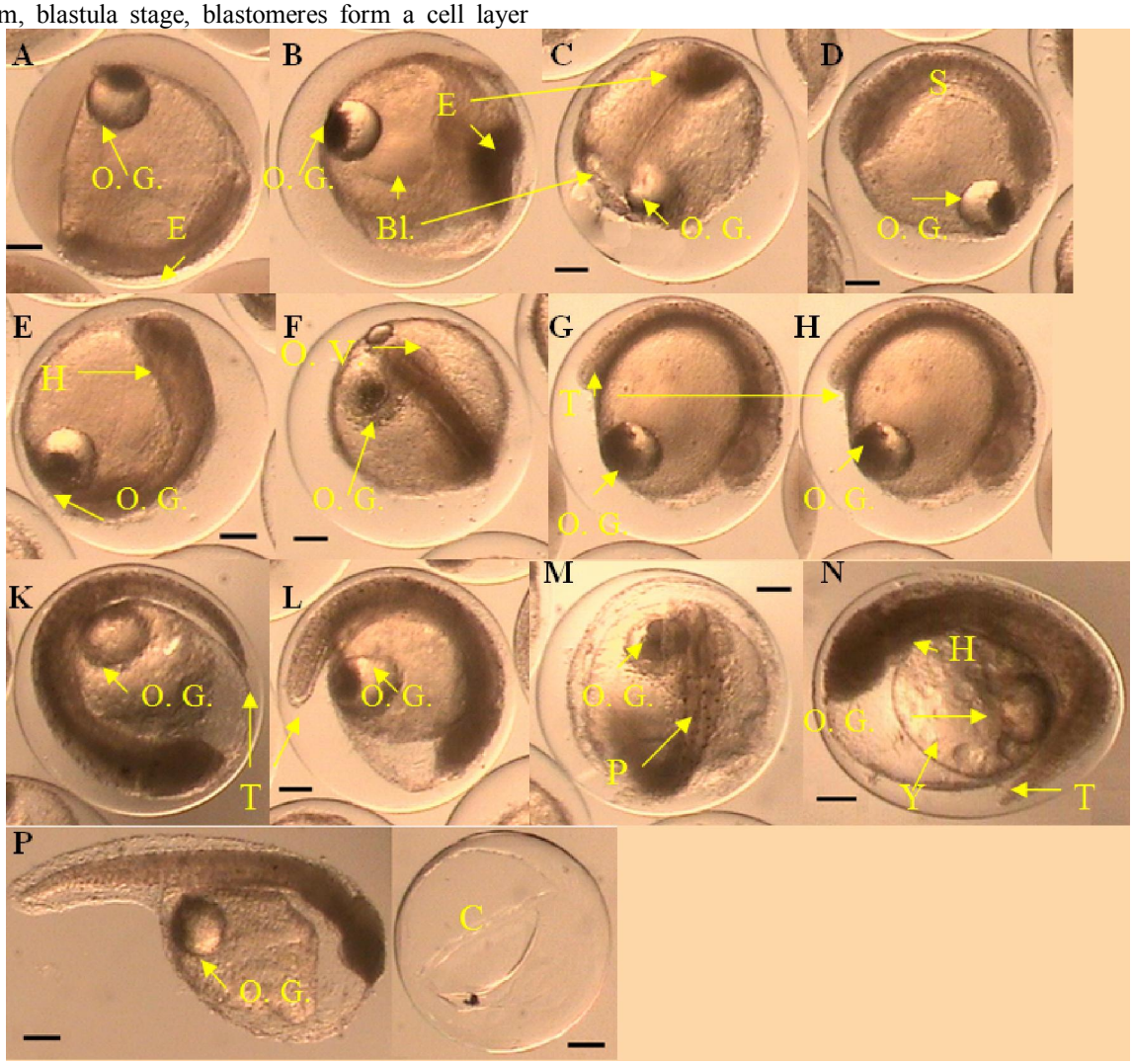

Fig. 2 (A to P): Yellow fin sea bream embryonic stages, left to right A: Observation Embryo Profile; B & C: Closing of blastopore; D: The Formation of Somite; E: The Appearance of Heart; F: The Formation of Optic Cup; G & H, K, L: Tail bud period; M: Increasing of Pigmentation; N: Start of dezhatching; P: Hatching (Abbreviations, Bl: Blastopore, O.G.: Oil Globule, S:Somite, H.:Heart, O. V.: Optic Vesicule, S. T.:Tail, P: Pigment, Y: Yolk sack, C: Corion)

Early gastrula: Blastolation when finished. The egg stage is Gastrulation (Figure: 1-L). The embryo at this stage is called embryonic shield (Kimmel *et al*., 1995).

Gastrulation 1/2: The growth of the embryo in the egg yolks and half the fish to form a hemisphere around the yolk is visible (Figure: 1-M). In these stage emboly layer has two layers.

Neurula: End of gastrulation and organ regeneration

(Organogenesis) begins in the egg. At this time the nerve cord (Neural tube) will be back in the ectoderm (Figure: 1-N).

Observation Embryo Profile: *A. latus* embryos at this point in the profile appear. Notochord is formed in this step (Figure: 2-A). Embryos at this stage is completely immobile and critical activities are performed as before (Nutrition of the yolk and breathing is performed on all surfaces). The head is thicker than the other end of the embryo.

Closing of blastopore stage:

Blastopore a roughly circular area in the egg yolk is teleost before the end of the embryo does not cover any Epiboly, so close blastopore, as well as all the steps epiboly. At this stage the embryo is fully developed, so that the sheath surrounding the yolk into the hole to block blastopore (Figure: 2-B, C).

The Formation of Somite stage: Somitogenesis occurs at this stage (Figure: 2-D). During embryonic development the somites that create organs such as the spine, machine shed, and other digestive tract is the body.

The appearance of heart stage: The heart appears. Heart is positioned just below the head and the throat (Figure: 2-E).

The Formation of Optic Cup stage: The eye vesicle appears to be two clear oval bubble. The tail bud at the end of the embryo starts to grow (Figure: 2-F, G, H, K, L).

Increase of Pigmentation stage: The sensible way than before, increasing the density of pigment was observed. The eyes may also develop, as the eyes of fetus has circular lens (Figure: 2-M).

Start of hatching (10%) stage: The whole fish embryos and larvae can become. Fetal movements and pressure into the corion eggs out of a perfectly spherical and are roughly oval or ovoid (Figure: 2-N).

Hatching (100%) stage: At this stage, all eggs hatched and the corion is left.

Oral and anal newborn larvae is closed, So they do not have the ability to get foreign food and their only source of food and energy supplies is the yolk sac and oil globule (Figure: 2-P).

In our study, egg and oil globule diameters (Table 1) were lightly smaller to another sparidae species were mesard, for example: those obtained by artificial fecundity of red porgy captured in Argentine shelf and described by Ciechomski & Weiss (1973) and Kentouri *et al*. (1992), the egg size from Mediterranean Sea red porgy, obtained by natural spawning. The range of egg sizes could change according to the period of observations within the spawning season and the different considered areas (Laura *et al,* 2003).

Table 1: Components eggs and oil globule diameter in different studies

Species	Egg diameter (µm)	Oil globule diameter (µm)	Author
Pagrus pagrus	810-880	176-194	Ciechomski & Weiss (1973)
	980-1025	250±7	Kentouri *et al*. (1992)
	890-930	180-200	Machinandiarena *et al*. (2003)
Pagrus major	660-1030	250	Fukuhara (1985)
	940-1050	-	Estévez (1991)
	900-1100	-	Pillay (1995)
Sparus aurata	1000-1030	220-250	Méndez (1994)
	1.001±0.005	0.217±0.001	Okan Kamacı *et al.,*2005
Archosargus rhomboidalis	800-940	800-940	Houde & Potthoff (1976)
Acanthopagrus latus	740.33±0.012	185±0.005	This study

Also less than average diameters of Gilthead Sea Bream eggs were determined Okan Kamaci *et al.* in 2005, approximately 1.001±0.005 mm and 0.217±0.001 mm, respectively. Egg and oil globule diameters measured in their study were relatively similar with the other author's results (Uçal, 1983; Glamuzina *et al.*, 1988; Camus and Koutsikapoulos, 1984). It might be thought that natural conditions (temperature, food, geographic location) and broodstock management (salinity, temperature, nutrition) in captivity could be effected broodstock and egg quality (Okan *et al*, 2005).

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Corresponding Author:
Dr G. Mohammadi South of Iran Aquaculture Research center
gmohammady@gmail.com

References:

1. Abol-Munafi, A. B. & Umeda, S.1994. The gonadal cycle of the yellow porgy, *Acanthopagrus latus* (Hottuyn) reared in the net cage at To sa Bay, Japan. Suisanzoshoku 42: 135-144.
2. Abu-Hakima, R. 1984. Some aspects of the reproductive biology of *Acanthopagrus spp.* (Family: Sparidae). Journal of Fish Biology 25:515-526.
3. Abou-Seedo, F. S., Dadzie, S. & Al-Kanaan, K. A. 2003. Sexuality, sex change and maturation Patterns in the yellow fin sea bream, *Acanthopagrus latus* (Teleostei: Sparidae) (Hostuyn,1782). Journal of Applied Ichthyology 19: 65-73.
4. Al-Kanaan, K. A. 1999. Cyclical changes in the histology of the gonads and the biology of Reproduction of the hermaphroditic yellow fin sea bream *Acanthopagrus latus* (Hottuyn). M. Sc. thesis. Kuwait niversity. 222pp.
5. Boulineau, C. F. 1974. Ponte naturelle et ponte induite par injektions hormonales chez Dicentrarchus labrax en Captiuite Collog. Aquaculture, 151–156.
6. Bromage, N. R., and R. Roberts. 1995 Broodstock Management and Egg and Larval Quality. Blackwell Science, USA, 424 pp.
7. Camus, P., and C. Koutsikopoulos. 1984. Incubation experimentale et developpement embryonnaire de la daurade royale, *Sparus aurata*, a differant temperatures. Aquaculture, 42:117-128.
8. Ciechomski, J. D. de & G. Weiss. 1973. Desove y desarrollo embrionario y larval del besugo, *Pagrus pagrus* (Linne) en el Mar Argentino (Pisces, Sparidae). Physis, Secc. A, 32(85): 481-487.
9. Estévez, A. 1991. Fecundación y desarrollo embrionario Reproducción de peces cultivados N°7. Canselleria de Pesca, Marisqueo e Acuicultura, Xunta de Galicia, 17 pp.
10. Foscarini, R., 1988. A review: intensive farming procedure for red sea bream (*Pagrus major*) in Japan. Aquaculture 72, 191e246.
11. Freddi, A. 1985. Sea Bass (*D. labrax*) and Gilthead Sea Bream (*S. aurata*) larval rearing. F. A. O. Project Regional Mediterranean de Development de L' aquaculture, pp: 62.
12. Fukuhara, O. 1985. Functional morphology and behavior of early life stages of red sea bream. Bull. Japan. Soc. Sci. Fish., 51(5): 731-743.
13. Glamuzina, B., and J. Jug. Dujakovic. 1988. Preliminary results of temperature shock effects on newly fertilized eggs of Gilthead Sea Bream (*S. aurata* L.1758). Institute of Oceanography and Fisheries, Split, Yugoslavia., No:71, 5pp.
14. Houde, E. D. & T. Potthoff.. 1976**.** Egg and larval development of the sea bream *Archosargus rhomboidalis* (Linnaeus): Pisces, Sparidae. Bull. Mar. Sci., 26(4): 506-529.
15. Ingram, B. A., McKinnon, L. J., Gooley, G. J., 2002. Growth and survival of selected aquatic animals in two saline groundwater evaporation basins: an Australian case study. Aquaculture Research 33, 425e436.
16. Kailola, P. J., Williams, M. J., Stewart, P. C., Riechelt, R. E., McNee, A., Grieve, C., 1993. Australian Fisheries Resources. Department of Primary Industries and Energy and the Fisheries Research and Development Corporation Canberra, 422 pp.
17. Kentouri, M., G. Koumoundouros, P. Divanach & A. Sterioti. 1992**.** The embryonic development of red porgy (*Pagrus pagrus*) and of common dentex (*Dentex dentex*) in Crete. Proceedings of the XXXIII C. I. E. S. M. Congress, 12-17 October, Trieste, 3 pp.
18. Kinoshita, Y.1939. Studies on sexuality of genus Sparus (Teleostei). Journal of Science of Hiroshima University, Series B, Division1,7:25-37.
19. Laura Machinandiarena, Mónica Müller & Andrea López, 2003, Early life stages of development of the red porgy *Pagrus pagrus* (Pisces, Sparidae) in captivity, Argentina. Invest. Mar., Valparaíso, 31(1): 5-13, 2003
20. Mendez, E. 1994. Data monitoringin I. M. B. C., an application in Broodstock Management. Institute of Marine Biology, Aquaculture Department, Crete, 20 pp.
21. Nash, C. E., and C. Kuo. 1975. Hypothesis for problems impeding the mass propagation of Grey Mullet and Other Finfish. Aquaculture, 5: 119-133.
22. Nelson, J. S., 1994. Fishes of the World. Wiley, New York, NY, 600 pp.
23. Norriss J. V. and G. Jackson.2002. Identifying the developmental stages of preserved eggs of snapper, *Pagrus auratus*, from Shark Bay,

Western Australia Fisheries Research Report [Western Australia] No. 142, 2002.
24. Okan Kamacı H., Şahin Saka, Kürşat Fırat. 2005. The Cleavage and Embryonic Phase of Gilthead Sea Bream (*Sparus aurata* Linnaeus, 1758) Eggs. Journal of Fisheries & Aquatic Sciences 2005, Cilt/Volume 22, Sayı/Issue (1-2): 205–209. Ege University Press.
25. Pillay, T. V. R. 1995**.** Seabasses and seabreams. Aquaculture, principles and practices. Fishing News Books, Oxford, 575 pp.
26. Smith, J. L. B., 1938. The South African fishes of the families Sparidae and Denticidae. Trans. R. Soc. S. Africa. 26, 225–305.
27. Smith, J. L. B., Smith, M. M., 1986. Family No. 183: Sparidae. In: Smith, M. M., Heemstra, P. C. (Eds.), Smith_s Sea Fishes. Macmillian, Johannesburg, South Africa, pp. 1–1050.
28. Uçal, O. 1983. Embriyonic development of gilthead sea bream (*Sparus aurata)* eggs. Journal of the Faculty of Science. Series B: 11:87-88. Bornova İZMİR.

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