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Effect of Some Morphometric Characteristics on Egg Quality in Common Dentex, *Dentex dentex* (Linnaeus, 1758)

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Abstract

In this study, egg quality determination of common dentex (*Dentex dentex*) was investigated by using egg, yolk and oil globule diameter from the first division to the hatching, during natural and photoperiodic manipulation of spawning time. In the viable, floating eggs, the minimal and maximal diameter of the egg, yolk and oil globule were measured. Based on these measurements several parameters were calculated describing the shape of the egg, yolk and oil globule and the size relationship between these compartments. Hatching rate was calculated as 92% in natural spawning time (NST) and 61% photoperiodic manipulation of spawning time (PMST). Also, average egg diameter was measured as 0.949±0.038 mm in NST and 0.911±0.014 mm in PMST. In NST, egg diameter and yolk diameter of the eggs were significantly bigger than eggs in PMST ($P<0.05$). The morphometric parameters of oil globule could be accepted as an indicator for description of quality criteria of eggs.

Keywords: *Dentex dentex*, egg quality, morphometry, embryological development.

Sinarit'lerde, *Dentex dentex*, Yumurta Kalitesi Üzerine Bazı Morfometrik Karakterlerin Etkisi

Özet

Bu çalışmada, sinaritlerde (*Dentex dentex*), ilk bölünmeden yumurtadan çıkışa kadar olan süre zarfında, yumurta, vitellüs ve yağ damlasının çapları, doğal ve fotoperiyot uygulamasının yapıldığı dönemler boyunca yumurta kalitesini tanımlamak için incelendi. Canlı ve yüzen yumurtalarda yumurta, vitellüs ve yağ damlasının minimum ve maksimum çapı ölçüldü. Ölçülen bu parametreler temelinde yumurta, vitellüs ve yağ damlasının şekli ve bu bölümler arasındaki boyut ilişkisi tanımlanarak hesaplandı. Yumurtadan çıkış oranı doğal yumurtlama sezonunda (NST) %92 ve yumurtalama zamanının fotoperiyodik olarak değiştirildiği dönemde (PMST) %61 olarak hesaplandı. Ayrıca, ortalama yumurta çapı NST döneminde 0,949±0,038 mm ve PMST döneminde 0,911±0,014 mm olarak ölçüldü. NST döneminde yumurtanın, yumurta çapı ve vitellüsün çapı PMST dönemindeki yumurtalardan önemli ölçüde daha büyüktür ($P<0,05$). Bununla birlikte yağ damlasının morfometrik parametreleri, yumurtaların kalite kriterlerinin tanımlanması için bir belirleyici olarak kabul edilebilir.

Anahtar Kelimeler: *Dentex dentex*, yumurta kalitesi, morfometri, embriyolojik gelişim.

Introduction

Egg quality is significant for the production of high quality fish larvae and for economical utilization of hatcheries. In fish culture, egg quality control is necessary in species that have recently been introduced in culture and for which reproduction techniques are still in development for marine fish (Lahnsteiner and Patarnello, 2004). 'Egg quality' is recently defined as the potential of an egg to hatch into a viable larva (Kjorsvik *et al*., 1990; Brooks *et al*., 1997). Fish egg quality can be affected by maternal age and condition factor, the timing of the spawning cycle, overripening processes, genetic factors, and also by intrinsic properties of the egg itself (Kjørsvik *et al*., 1990; Brooks *et al*., 1997). The composition of the broodstock diets is believed to have a great influence on the reproduction and egg quality of several fish species (Brooks *et al*., 1997).

Common dentex (*Dentex dentex*) has been considered as a promising species for aquaculture in the Mediterranean coast, due to its high market price and growth rate. Common dentex is a batch spawner that usually spawns at nightfall or early morning (Abellan, 2000) for a long period of up to 40–50 days and the number and size of the eggs released in each batch varies over the spawning season as well as the quality between egg batches (Gimenez *et al*., 2006). One of the main problems of common dentex is very carnivorous and cannibalistic species under intensive culture condition (Efthimiou *et al*., 1994). This situation results the high mortality rate during the larval phase, especially in the early feeding period with rotifers (Glamuzina *et al*., 1989). The need for a precise estimation of egg quality is therefore of paramount importance in order to clarify if the low survival rate during early larval rearing is due to the initial viability of the larvae or the quality of the eggs. Hatchery production can be optimized by starting the production cycle with high-quality eggs giving high egg survival and hatching rates and robust larvae with better growth, survival and stress resistance.

Several morphological (Kjorsvik *et al*., 1990; Thorsen *et al*., 2003) and biochemical parameters such as lipids (Bell and Sargent, 2003), amino acids (Rodriguez *et al*., 1998) or vitamins (Maeland *et al*., 2003) have been considered as indicators of egg quality. Recently, several compounds and enzymes involved in carbohydrate metabolism have been identified as good markers for egg quality in other Sparidae species such as *Sparus aurata* and *Puntazzo puntazzo* (Lahnsteiner and Patarnello, 2004).

The eggs of cultured marine fish species are small and transparent and therefore may be suitable for egg quality determination using morphological parameters. Therefore to investigate whether egg morphology can be used as an egg quality index the present study was conducted on *Dentex dentex*.

Materials and Methods

Experiments were performed in a commercial hatchery in İzmir, Turkey, with eggs from natural (20/04/2009) and artificial advanced (14/01/2009) spawn (photoperiodic manipulation of spawning time) *Dentex dentex*. Each group broodstock, eight females (2.5 kg mean weight) and eight males (1.5 kg mean weight), were selected from wild breeders and stocked (5 kg/m^3) in an 18 m^3 tank with a sea-water supply of 35 L min^{-1}. Frozen cuttlefish (*Sepia officialis*) and shrimp (*Palaemon elegans*) were the primary food source and were provided daily for both broodstock groups. The fish of both groups were subjected to artificial photoperiod, and the water temperature varied throughout the experimental period between 17.0°C and 17.5°C, eggs were collected from the spawning tanks by overflow into egg collectors which placed outside the spawning tank. Collected eggs were separated into floating and non-floating. Non-floating eggs were discarded. From the floating eggs 20 g (natural spawning time) and 32 g (photoperiodic manipulation of spawning time) was taken for morphological development. Egg samples of both groups were taken after 30 days beginning of spawning period. The hatching rates (%) were calculated based on the number of fertilized eggs put into the incubators and the number of larvae appearing after hatching.

The shapes of the egg, yolk and oil globule were analyzed in both experimental groups. In each sample of group 80 randomly selected eggs were analyzed by using Olympus DP-20 BSW software for the morphometric measurements. The maximum and minimum axis of the best fitting ellipse were measured to the nearest µm and used for subsequent calculations (Figure 1; Lahnsteiner and Patarnello, 2005). Measured and calculated parameters are shown in Table 1 (Lahnsteiner and Patarnello, 2005). The mean value was taken for the parameters measured in each sample and used for subsequent statistical analysis. Analysis of variance (ANOVA) was used to compare the mean values of morphological parameters between the different embryonic stages (blastula, gastrulation, neurula, observation of embryo

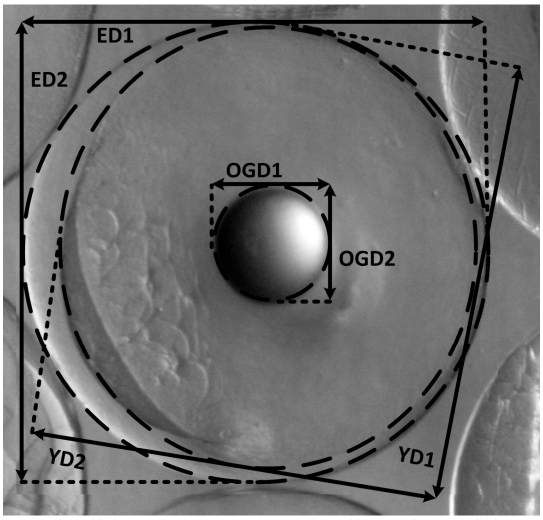

Figure 1. Morphometric measurement detail in *D. dentex* eggs. The dimensions of the 2 major axes (minimal and maximal diameter) were measured for each ellipse. ED, egg diameter; YD, yolk diameter; OGD, oil globule diameter.

profile, formation of optic cup and before hatching). Student's *t* test was used to compare the mean values of the data of spawning time. Embryological stage and terminology was followed by Saka *et al.* (2004).

Results

Common dentex eggs in both experimental groups were buoyant, transparent, and typical of sparid fish. Hatching rates were founded 61% in photoperiodic manipulation of spawning time (PMST) and 92% in natural spawning time (NST). The mean diameter of the egg for the all embryonic development stage ranged from 0.873 to 0.937 mm with a mean 0.911±0.014 mm in PSMT. Also, the mean diameter of the egg in NST ranged from 0.911 to 1.061 mm with a mean 0.949±0.038 mm. The mean oil globule diameter for the all embryonic development stage ranged from 0.162 to 0.232 mm with a mean 0.206±0.009 mm in PMST and from 0.165 to 0.239 mm with a mean 0.223±0.012 mm in NST. The mean yolk diameter for the all embryonic development stage ranged from 0.765 to 0.915 mm with a mean 0.821±0.039 mm in PMST and from 0.798 to 0.932 mm with a mean 0.853±0.022 mm in NST.

For eggs in NST the mean diameter of the egg and the mean diameter of the yolk were bigger than for eggs in PMST (Table 2). The mean diameter of the egg was not significantly different both in embryonic development stages and in spawning periods (PMST and NST). The mean oil globule diameter in both spawning period eggs was decrease related to the embryonic development stages (Table 2). The mean diameter of yolk was not correlation both in spawning period and in embryonic development stages. In the periods of formation of optic cup and before hatching mean oil globule

Table 1. Morphometric parameters measured and calculated in eggs of *D. dentex*

Evaluated parameters	Abbreviations and formula
Measured morphometric chracters	
Minimal and maximal diameter of egg	MinED & MaxED
Minimal and maximal diameter of yolk	MinYD & MaxYD
Minimal and maximal diameter of oil globule	MinOGD & MaxOGD
Calculated parameters	
Mean egg diameter	MED=(MinED+MaxED)/2
Mean yolk diameter	MYD=(MinYD+MaxYD)/2
Mean oil globule diameter	MOGD=(MinOGD+MaxOGD)/2
Ratio of maximal to minimal diameter of egg	RED=MaxED/MinED
Ratio of maximal to minimal diameter of yolk	RYD=MaxYD/MinYD
Ratio of maximal to minimal diameter of oil globule	ROGD=MaxOGD/MinOGD
Ratio mean diameter egg/yolk	REYD=MED/MYD
Ratio mean diameter egg/oil globule	REOGD=MED/MOGD
Ratio mean diameter yolk/oil globule	RYOGD=MYD/MOGD
Ratio mean diameter egg/yolk/oil globule	REYOGD=MED/(MYD*MOGD)
Shape coefficient of egg	ESC=((MaxED-MinED)/(MaxED+MinED)
Shape coefficient of yolk	YSC=((MaxYD-MinYD)/(MaxYD+MinED))
Shape coefficient of oil globule	OGSC=((MaxOGD-MinOGD)/(MaxOGD+MinOGD)

Table 2. Morphometric parameters of eggs in *D. dentex* during embryogenesis (mean±sd)

Embryonic Stage	Hatching Period	Mean egg diameter (mm)	Mean oil globule diameter (mm)	Mean yolk diameter (mm)
Blastula	PMST	0.910±0.020 ^{A,a}	0.206±0.010 ^{A,a}	0.868±0.025 ^{A,a}
	NST	0.947±0.028 ^{B,a}	0.225±0.009 ^{B,a}	0.845±0.027 ^{B,b}
Gastrulation	PMST	0.910±0.017 ^{A,a}	0.204±0.010 ^{A,a}	0.860±0.029 ^{A,a}
	NST	0.951±0.026 ^{B,a}	0.228±0.011 ^{B,b}	0.865±0.023 ^{A,b}
Neurula	PMST	0.909±0.021 ^{A,a}	0.218±0.010 ^{A,b}	0.728±0.010 ^{A,b}
	NST	0.950±0.026 ^{B,a}	0.229±0.010 ^{B,b}	0.854±0.024 ^{B,c}
Observation of embryo profile	PMST	0.912±0.018 ^{A,a}	0.219±0.010 ^{A,b}	0.811±0.061 ^{A,c}
	NST	0.952±0.025 ^{B,a}	0.222±0.011 ^{A,c}	0.861±0.018 ^{B,b}
Formation of optic cup	PMST	0.910±0.020 ^{A,a}	0.195±0.015 ^{A,c}	0.838±0.047 ^{A,d}
	NST	0.949±0.026 ^{B,a}	0.216±0.013 ^{A,d}	0.850±0.021 ^{B,c}
Before hatching	PMST	0.914±0.016 ^{A,a}	0.194±0.016 ^{A,c}	0.787±0.046 ^{A,e}
	NST	0.950±0.025 ^{B,a}	0.216±0.012 ^{B,d}	0.822±0.032 ^{B,d}

NS, Natural spawning time; PMST, photoperiodic manipulation of spawning time. Values showing the same superscript letter are not significantly different ($p>0.05$). Upper case letters compare same columns and lower case letters compare embryonic stage in same spawning period.

diameter decreased while ratio of maximal to minimal diameter of egg, ratio of maximal to minimal diameter of yolk, ratio of maximal to minimal diameter of oil globule, shape coefficient of egg, shape coefficient of yolk, and shape coefficient of oil globule increased (Table 2 and 3). The ratio of the maximal:minimal diameter of the egg and ratio of the maximal:minimal diameter of the yolk in natural spawning time was higher than in photoperiodic manipulation of spawning time (Table 3). The ratio of mean diameter egg/yolk, the ratio of mean diameter egg/oil globule, the ratio of mean diameter yolk/oil globule, and the ratio of mean diameter egg/yolk/oil globule remained variable (Table 4). The shape coefficient of egg and the shape coefficient of yolk increased only in PMST in the periods of formation of optic cup and before hatching. However, in that period the shape coefficient of yolk increased in NST.

Discussion

In the current study, we investigated egg morphology of *Dentex dentex* according to spawning time with simple morphometric measurements. The morphometric measurements could be defined as minimal and maximal diameter of the egg (MinED & MaxED), of the yolk (MinYD & MaxYD) and of the oil globule (MinOGD & MaxOGD) and by subsequent calculation of different ratio values for these parameters. As reported by Lahnsteiner and Patarnello (2005), digitized pictures and computer assisted measurements allow reliable determinations, the efficiency of the computer program determining the speed of the analysis. For the egg, the yolk, and the oil globule the calculation of the ratio of the maximal to minimal diameter and the calculation of the shape coefficient allowed the characterization of the shape of these compartments (Lahnsteiner and

Table 3. Changes in morphometric parameters of eggs in *D. dentex* during embryogenesis (mean±sd)

Embryonic Stage	Hatching Period	RED	RYD	ROGD	ESC	YSC	OGSC
Blastula	PMST	0.975±0.017 ^{A,a}	0.910±0.039 ^{A,a}	0.956±0.031 ^{A,a}	1.278±0.882 ^{A,a}	2.281±1.675 ^{A,a}	2.281±1.652 ^{A,a}
	NST	1.027±0.020 ^{B,a}	1.069±0.058 ^{B,a}	1.038±0.028 ^{B,a}	1.337±0.982 ^{A,a}	1.881±1.174 ^{A,a}	1.830±1.027 ^{B,a}
Gastrulation	PMST	1.015±0.013 ^{A,a}	1.039±0.042 ^{A,b}	1.034±0.020 ^{A,a}	0.744±0.638 ^{A,a}	4.117±1.024 ^{A,b}	1.644±0.980 ^{A,a}
	NST	1.023±0.021 ^{B,a}	1.087±0.046 ^{B,b}	1.042±0.029 ^{B,a}	1.128±1.017 ^{B,b}	1.881±0.936 ^{B,b}	2.058±1.363 ^{B,a}
Neurula	PMST	1.014±0.014 ^{A,a}	1.029±0.026 ^{A,b}	1.036±0.021 ^{A,b}	1.747±1.003 ^{A,b}	6.606±1.497 ^{A,c}	1.747±1.003 ^{A,b}
	NST	1.020±0.016 ^{A,a}	1.149±0.038 ^{B,c}	1.048±0.038 ^{B,a}	0.981±0.770 ^{B,b}	1.416±1.038 ^{B,c}	2.320±1.784 ^{B,a}
Observation of embryo profile	PMST	1.018±0.016 ^{A,b}	1.030±0.021 ^{A,b}	1.038±0.022 ^{A,b}	1.859±1.053 ^{A,c}	5.110±1.787 ^{A,b}	1.859±1.053 ^{A,c}
	NST	1.018±0.014 ^{A,a}	1.113±0.056 ^{B,d}	1.050±0.038 ^{B,a}	0.874±0.673 ^{B,b}	1.470±1.002 ^{B,c}	2.385±1.749 ^{B,b}
Formation of optic cup	PMST	1.014±0.010 ^{A,a}	1.044±0.030 ^{A,c}	1.053±0.022 ^{A,c}	2.542±1.917 ^{A,a}	6.973±2.922 ^{A,d}	2.542±1.917 ^{A,a}
	NST	1.024±0.020 ^{B,a}	1.152±0.067 ^{B,e}	1.086±0.075 ^{B,a}	1.156±0.973 ^{B,b}	2.113±1.416 ^{B,b}	3.985±1.302 ^{B,b}
Before hatching	PMST	1.017±0.015 ^{A,b}	1.066±0.044 ^{A,d}	1.076±0.069 ^{A,d}	3.539±1.992 ^{A,c}	9.725±1.689 ^{A,d}	3.359±1.992 ^{A,c}
	NST	1.022±0.017 ^{A,a}	1.221±0.051 ^{B,f}	1.054±0.058 ^{B,a}	1.067±0.816 ^{B,b}	3.154±1.915 ^{B,d}	2.535±1.585 ^{B,a}

Abbreviations are listed in Table 1.
NS, Natural spawning time; PMST, photoperiodic manipulation of spawning time.
Values showing the same superscript letter are not significantly different ($P>0.05$).
Upper case letters compare same columns and lower case letters compare embryonic stage in same spawning period.

Table 4. Changes in morphometric parameters of eggs in *D. dentex* during embryogenesis (mean±sd)

Embryonic Stage	Hatching Period	REYD	REOGD	RYOGD	REYOGD
Blastula	PMST	1.064±0.027 ^{A,a,c}	4.335±0.221 ^{A,a}	4.078±0.233 ^{A,a}	5.124±0.291 ^{A,a}
	NST	1.091±0.034 ^{B,a}	4.206±0.204 ^{B,a}	3.857±0.192 ^{B,a}	4.846±0.232 ^{B,a}
Gastrulation	PMST	1.053±0.025 ^{A,b}	4.458±0.203 ^{A,b}	4.238±0.213 ^{A,b}	5.160±0.279 ^{A,a}
	NST	1.107±0.034 ^{B,b}	4.190±0.269 ^{B,a}	3.786±0.247 ^{B,a}	4.875±0.286 ^{B,a}
Neurula	PMST	1.065±0.024 ^{A,a,c}	4.172±0.178 ^{A,c}	3.920±0.181 ^{A,c}	4.887±0.255 ^{A,b}
	NST	1.331±0.201 ^{B,c}	4.167±0.255 ^{B,a}	3.196±0.493 ^{B,c}	5.829±0.902 ^{B,b}
Observation of embryo profile	PMST	1.060±0.013 ^{A,a}	4.170±0.167 ^{A,c}	3.935±0.181 ^{A,c}	4.845±0.255 ^{A,b}
	NST	1.180±0.091 ^{B,d}	4.298±0.249 ^{B,b}	3.661±0.332 ^{B,d}	5.342±0.497 ^{B,c}
Formation of optic cup	PMST	1.071±0.011 ^{A,c}	4.691±0.167 ^{A,d}	4.379±0.315 ^{A,d}	5.523±0.424 ^{A,c}
	NST	1.135±0.054 ^{B,e}	4.419±0.314 ^{B,c}	3.903±0.356 ^{B,a}	5.271±0.365 ^{B,c}
Before hatching	PMST	1.102±0.034 ^{A,d}	4.665±0.218 ^{A,b}	4.238±0.235 ^{A,b}	5.686±0.345 ^{A,c}
	NST	1.208±0.075 ^{B,f}	4.404±0.283 ^{B,c}	3.660±0.325 ^{B,d}	5.611±0.389 ^{A,b}

Abbreviations are listed in Table 1.
NS, Natural spawning time; PMST, photoperiodic manipulation of spawning time.
Values showing the same superscript letter are not significantly different ($P>0.05$).
Upper case letters compare same columns and lower case letters compare embryonic stage in same spawning period.

Patarnello, 2005; Lahnsteiner *et al*., 2008). For the ratio of mean diameter egg/yolk, the ratio of mean diameter egg/oil globule, and the ratio of mean diameter yolk/oil globule a value of 1 and shape coefficient of egg, shape coefficient of yolk, and shape coefficient of oil globule a value of 0 indicated an ideal spherical shape, while increasing value deviations indicated an ellipsoidal (Lahnsteiner and Patarnello, 2005). In addition to above, ratio of maximal to minimal diameter of egg, yolk and oil globule values should be near 1 for the ideal ellipsoidal.

Several authors pointed out that hatching success is normally more correlated to the rate of abnormal blastomeres (early cell development) than to the fertilization rate or to the hatching rate in marine fishes such as Atlantic cod (Kjorsvik and Lonning, 1983; Kjorsvik *et al*., 1994), wolfish, *Anarhichas lupus*, (Pavlov and Moksness, 1994), turbot (Kjorsvik *et al*., 2003) and in planktonic samples of wild fish eggs (von Westernhagen *et al*., 1988). As reported by Shield *et al.* (1997), blastomere morphology at the 8 cell stage in Atlantic halibut corresponds closely to survival to hatch. However, spherical and very ellipsoidal oil globules are indicators of low embryonic survival and therefore of low egg quality while eggs with slightly ellipsoidal oil globules indicate high embryonic survival (Lahnsteiner *et al*., 2008). The present study outcomes confirm results by Lahnsteiner and Paternello (2005) on *S. aurata* and *D. puntazzo* that the shape of the oil globule was an egg quality marker in *D. dentex*. The shape of the oil globule in natural spawning time eggs was very homogenous within the samples. However, eggs in photoperiodic manipulation of spawning time were either only spherical or very ellipsoidal oil globule.

It is well known that the shape of a lipid droplet is influenced by its membrane lipid composition, by its internal lipid content, and by its lipid to water ratio (Kralchevsky *et al*., 1995; Lahnsteiner and Patarnello, 2005). Moreover, between a lipid droplet and the surrounding water phase there are interactions due to hydrophilic and hydrophobic bonds which also influence the vesicle shape (Kralchevsky *et al*., 1995). Therefore, the shape of a oil globule can be considered to be a result of its interaction with the cellular environment (Svetina and Zeks, 2002) and an index for its lipid composition (Lahnsteiner and Patarnello, 2005). As demonstrated in many studies the lipid composition of an egg influences its viability (Navas *et al*., 1997; Rodriguez *et al*., 1997, 1998). In *Gadus morhua* significant correlations between hatching rate and docosahexaenoic/eicosapentaenoic acid levels were found (Pickova *et al*., 1997). In the Asian sea bass *Lates calcarifer* the levels of total saturated fatty acids, and of docosahexaenoic acid were correlated with embryo viability (Nocillado *et al*., 2000). Extremely non-axisymmetric, ellipsoid oil globules may be a transition shape during expulsion of small vesicles from larger ones (Lipowsky, 1991). Also, viability of the eggs in sparidae can be directly effected survival of eggs and larva after hatching (Lahnsteiner and Patarnello, 2005; Lahnsteiner *et al*., 2008).

Photoperiod manipulation has been successfully used to modulate sexual maturation cycles in several finfish species from northern latitudes including Atlantic salmon, *Salmo salar* (Taranger *et al*., 1998); rainbow trout, *Oncorhynchus mykiss* (Bromage *et al*., 1984); Atlantic halibut, *Hippoglossus hippoglossus* (Björnsson *et al*., 1998); turbot, *Scophthalmus maximus* (Devauchelle *et al*., 1988); sole, *Solea solea* (Devauchelle *et al*., 1988) and sea bass, *Dicentrarchus labrax* (Carrillo *et al*., 1989). In commercial hatcheries, photoperiod manipulation has been employed to both compress and delay normal seasonal maturational cycles in broodfish (Björnsson *et al*., 1998; Hansen *et al*., 2001) and thus provide year-round availability of eggs for incubation. Photoperiod manipulations that compress the time between successive spawning cycles have produced smaller eggs in rainbow trout (Bromage *et al*., 1984) and Atlantic cod (Hansen *et al*., 2001), but similar studies on egg diameter (Carrillo *et al*., 1989; Zanuy *et al*., 1995). Photoperiod manipulation experiments have not demonstrated an effect on fertilization rate or egg survival in rainbow trout (Bromage *et al*., 1984) and sea bass (Carrillo *et al*., 1989), but photoperiod manipulations that compress the interval between successive spawnings may negatively affect hatching success in sea bass (Mananos *et al*., 1997) and increase variability in viability among egg batches in sole (Devauchelle *et al*., 1988). Also, compression of the interval between successive spawning by photoperiod manipulation negatively impacts both number of eggs produced and individual egg size in cod irrespective of the photoperiod manipulation technique used (Penney *et al*., 2006). These findings are parallel with the obtained results from this study that photoperiodic manipulation of spawning time was significantly decreased of the egg diameter in *D. dentex* than natural spawning time.

The early development of fish is strongly affected by incubation temperature (Blaxter, 1988; Conides and Glamuzina, 2001). Optimal incubation temperature required for embryonic development of the eggs varies between the species. Gilthead sea bream (*Sparus aurata*) had optimal water temperature of 19°C with a range of ±3°C (Saka *et al*., 2004), which is a fairly wide one. For European sea bass (*Dicentrarchus labrax*), the optimal range is between 15°C and 17°C (Conides and Glamuzina, 2001). For red sea bream (*Pagrus major*), successful hatching is observed in water temperatures between 14.5°C and 25.6°C (Mihelakakis and Yoshimatsu 1998). For *D. dentex*, optimum temperatures for the development of eggs have ranged from 16°C to 18°C. As reported by Saka *et al*. (2004), the mean diameter of the eggs was 1.033±0.046 mm. The morphological quality of the eggs used in this study shows great similarities to those used by Glamuzina *et al*. (1989) and Abellan *et al*. (1997). Similar findings were described in our results.

The broodstocks are able to produce large quantities of eggs, but egg quality often varies greatly in a non-controllable way (Kjorsvik *et al*., 1990). The components that do affect egg quality include the endocrine status of the female during the growth of the oocyte in the ovary, the diet of the broodfish, the complement of nutrients deposited into the oocyte, and the physiochemical conditions of the water in which the eggs are subsequently incubated. The husbandry practices are probably the major contributory factors affecting egg quality in captive broodfish. It could be concluded that the shape of oil globule corresponds to egg quality in *D. dentex* supports the proposal of Lahnsteiner *et al*. (2008) that oil globule may be applicable for egg assessment in fish. The technique would be valuable both for research and for routine egg checking in hatcheries with blastomere morphology in viable egg. It is recommended that further observations be made on the other suited fish species.

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