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SOME BIOCHEMICAL ASPECTS OF REPRODUCTION IN FEMALE *TRACHINOTUS OVATUS* (CARANGIDAE)

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Key words: Trachinotus ovatus, Ovaries, Total proteins and amino acids, total lipids and fatty acids.

ABSTRACT

General pattern of gonadal development in female *Trachinotus ovatus* was divided into six maturity stages, which are; immature, maturing, nearly ripe, ripe, spawning and spent stages. The maximum value of gonadosomatic index (GSI) was attained in June and July. Total protein content in ovaries varied according to different maturity stages recording maximum value at immature ovaries and minimum at spawning and spent ovaries. The values of GSI in ovaries were inversely correlated to their total protein content at different maturity stages. Seven amino acids (proline, alanine, valine, methionine, isoleucine, leucine and histidine) were found to increase significantly in ripe ovary, followed by a significant decrease in both spawning and completely spent ovaries. While, arginine and threonine reached their maximum concentration in the spawning period. On the other hand, serine amino acid reached their minimum value in the ripe ovary. Total lipid contents of ovaries reached their minimal values at immature stage, while the maximum recorded value was at the nearly ripe gonad. The ovarian total lipid contents approximately followed the same manner of the GSI according to the different maturity stages except in spawning period. Many differences were detected in fatty acid concentrations in female *Trachinotus ovatus* ovaries in relation to different maturity stages. Eicosapentaenoic acid content varied according to the stage of sexual maturity. While, the maximum recorded value of arachidonic acid was at the ripe stage. Palmitic acid and oleic acid had the highest concentrations among fatty acids, while those with low concentrations were pentadecanoic acid and gadoleic acid.

INTRODUCTION

Trachinotus ovatus (Linnaeus 1758) belong to family carangidae, genus *Trachinotus*. Family *Carangidae* is economically important throughout the Mediterranean Sea (Smith-Vaniz and Berry, 1981. El-Gharabawy (1995) studied total proteins and amino acid contents of ovaries of *Solea vulgaris* in relation to sexual maturity stages. Srivastava *et al.* (1995) studied the changes in the amino acids during embryonic development of cultured and wild Atlantic salmon (*Salmo salar*). The importance of evaluating changes in the total protein (bounded and free) and free amino acid pools during developmental stages of teleost fish as means of understanding nutrition and physiology of energy partitioning during early ontogeny were reviewed by Ronnestad *et. al*. (1999). Assem (2001) studied protein and total amino acids profiles of gonads of *Dicentrarchus labrax* in relation to maturation stages. Gallagher *et al.* (1989 & 1991) studied seasonal variations in fatty acids in some fish species. Pernet *et al.* (2002) reported that the fluctuations of lipids and fatty acids were closely related to sexual

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development of the anthozoan *Renilla koellikeri*. Mahmoud and Allam (2002) studied protein and lipid concentrations in gonads of *Boop boops* in spawning, post spawning and rest stages. The aim of the present work is to investigate biological parameters that control spawning process and identify some biochemical and physiological characteristics in ovaries of female *Trachinotus ovatus* in relation to their different maturation stages.

MATERIAL AND METHODS

Fishes used in the present study were collected at regular intervals twice a mouth per a year. The sampled fish were dissected to determine sex and sexual maturity stage. Ovaries were examined and weighed. The gonadosomatic index (GSI) was calculated for each fish, after getting the total weigh (gm) and total length (cm).

Samples of ovaries were taken for total protein determination by using the micro-Kjeldahl method as reported by Michael (1987). Total proteins content were expressed as gram of 100-gram ovarian dry weight for each sample. Other samples were prepared for amino acid determination by using the method of acid hydrolysis according to Moore *et al.* (1958) and expressed as gram of 100-gram protein of ovarian dry weight for each sample.

Total lipids in ovarian samples were extracted by using chloroform-methanol-water (2:2:1.8) according to the method of Bligh and Dyer (1959). Lipid fractions were methylated to obtain fatty acid methyl esters according to Radwan (1978). Fatty acid methyl esters were analyzed using Shimadzu gas chromatography 4 CM with flame ionization. Both total lipids and fatty acids were expressed as concentration present of ovarian dry weight for each sample.

All data were statistically analyzed by Microsoft Excel program. The correlation coefficient and significance of data were calculated.

RESULTS

I - Sexual Maturity stages:

Six maturity stages of the species under study were described according to Zaki *et al.* (1995) and El-Gharabawy (1996) as follows:

I- Immature stage: In this stage, ovaries are almost cylindrical with two tapering ends. This stage is detected in fish with total length less than 15cm, and is present during the whole year. The mean GSI value of this stage was (0.75).

II- Maturation stage: Ovaries are pinkish in color. This stage is detected during the whole year. The mean GSI value of this stage was (1.08).

III- Nearly ripe stage: The nearly ripe ovaries are yellowish in colour. Usually forming two non-equal lobes connected to each other. The connection in between are not restricted to specific area. This stage is detected from April to mid May. The GSI value of this stage was (4.01).

IV- Ripe stage: At this stage, ovaries show the maximum development in size. Ovaries are orange yellowish in color. Eggs could be distinguished with the naked eye. This stage is detected throughout June and July. The mean GSI value of this stage was (4.24).

V- Spawning stage: Spawning ovaries started to decrease in the size gradually due to the interval discharge of sexual products. They are pale yellow in colour and innervated with blood vessels. This stage is detected from middle of August till the middle of October. The mean GSI value of this stage was (2.01).

VI- Spent stage: Ovaries are severely shrunken, flaccid, collapsed, reddish yellow in colour and much reduced in size. Ovaries at this stage contain a number of blood vessels externally. This stage is detected from late October till the end of December. The mean GSI value of this stage was (0.7).

Total protein and amino acid content in ovaries of *Trachinotus ovatus:*

I- Total protein:

Total protein content of *Trachinotus ovatus* ovaries reaching the peak value of (76.428 ± 2.742 g\100g ovarian dry weight) in the immature stage. Gradual decrease of total protein content was recorded as (75.168 ± 6.433 g\100g, 71.248 ± 8.204 g\100g and 68.156 ± 9.030 g\100g) in maturing, nearly ripe and ripe stages respectively. whereas the minimum values of (61.228 ± 6.776 g\100g and 61.253 ± 4.810 g\100g) were recorded in spawning and spent stages respectively. We notice an inverse relation between values of ovarian total protein and the values of GSI in different stages of sexual maturity (Table 1 and Figure 1).

Table (1): Total protein content in ovaries at different maturity stages of female *Trachinotus ovatus* (g/100g dry weight) in relation to gonadosomatic index (GSI) values.

Maturity stages	G.S.I.	Ovarian total protein			
		Minimum	Maximum	Average	± SD
Immature (whole year)	0.750	66.897	79.923	76.428	2.742
Mature (whole year)	1.080	65.886	78.752	75.168	6.433
Nearly ripe (April -mid May)	4.010	60.485	76.591	71.248	8.204
Ripe (late May to early Aug.)	4.240	65.201	82.109	68.156	9.030
Spawning (mid Aug. to mid Oct.)	2.010	55.241	64.824	61.228	6.776
Spent (Nov. & Dec.)	0.700	58.456	65.258	61.253	4.810

Insignificant correlation coefficient (r = 0.042 at p : 0.936)
number of samples (n = 9)

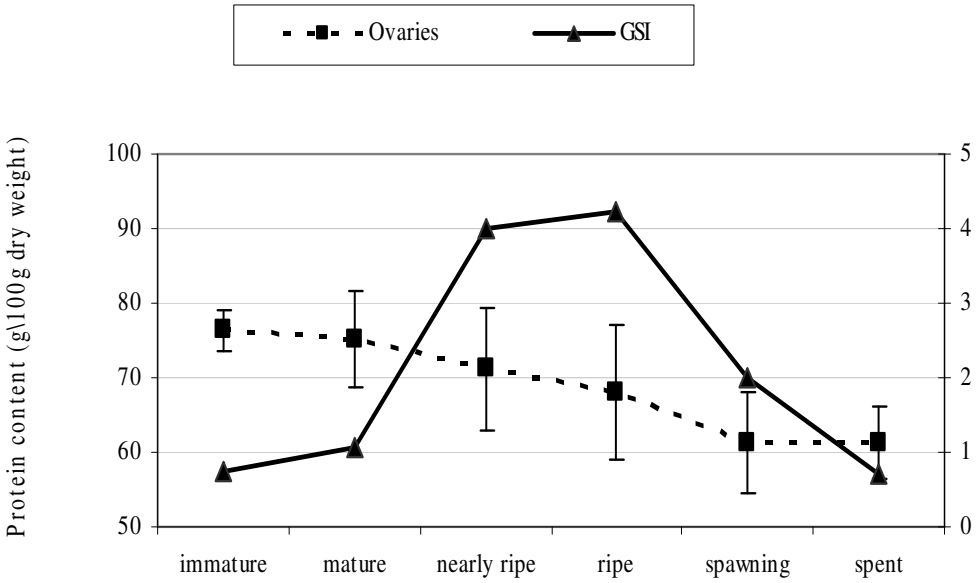

Figure (1): Total protein content of ovaries in different maturity stages of female Trachinotus ovatus in relation to gonadosomatic index values (GSI).

II- Amino acid:

The major amino acids present in ovaries of female *Trachinotus ovatus* during different maturity stages were **aspartic acid**, **glutamic acid** and **arginine**, While **cystine** had the lowest concentration (Table 2).

The concentration of **aspartic acid**, **threonine** and **serine** amino acids started to decrease from immature stage until reaching a minimum (3.248 and 2.486 g\100g protein of ovarian dry weight respectively) at ripe stage for both aspartic acid and serine. Threonine reached a minimum of (2.030 g\100g) at nearly ripe stage. Increased values were recorded for these amino acids till they reach a maximum of (6.928, 4.413 and 3.938 g\100g respectively) at immature stage. Both aspartic acid and threonine amino acid concentrations were significantly correlated with GSI values, while insignificant correlation was recorded between serine concentration and GSI values (Table 2).

Glutamic acid concentration fluctuated in relation to different maturity stages (Table 2). The maximum concentration recorded value was (8.190 g\100g) at spawning stage. The minimum recorded value of this amino acid was (5.157 g\100g) at immature stage. Glutamic acid concentration was insignificantly correlated with GSI values.

The concentration of **proline**, **alanine**, **valine** and **histidine** amino acids started to increase from immature stage until they reaching a maximum of (4.115, 4.736, 3.436 and 2.016 g\100g respectively) at ripe stage. The minimum recorded values of those amino acids were (1.950, 2.621, 1.940 and 1.198 g\100g respectively) at immature stage. Insignificant correlation was recorded for alanine, while proline, valine and histidine amino acids concentrations were significantly correlated with GSI values of different maturity stages. (Table 2).

The concentration values of **glycine** amino acid fluctuated reaching the maximum during spent period recording (2.751 g\100g), while the minimal value obtained was (1.777

g\100g) at ripe stage. Glycine acid concentration was insignificantly correlated with GSI values. (Table 2).

The maximum concentration of **cystine**, **tyrosine**, **phenylalanine** and **arginine** amino acids recorded values were (0.266, 2.057, 2.890 and 5.096 g\100g respectively) at spawning stage. The minimum recorded values of those amino acids were (0.026, 1.388, 2.031 and 2.675 g\100g respectively) at immature stage (Table 2). Significant correlation was recorded only for tyrosine concentration with GSI values, while the other three amino acids were insignificantly correlated.

Methionine, isoleucine and **leucine** amino acids concentration values started to increase from immature stage until reaching the maximum of (2.111, 2.981 and 4.017 g\100g respectively) at ripe stage. The minimum-recorded values of these amino acids were (0.936, 1.837 and 2.466 g\100g respectively) at immature stage. These amino acids were insignificantly correlation with GSI values of different maturity stages (Table 2).

Concentration values of **lysine** amino acid increased until it reached the maximum-recorded value of (4.397 g\100g) at nearly ripe stage. The minimum-recorded value was (3.584 g\100g) at spawning stage. Lysine acid concentration was insignificantly correlated with GSI values.

Table (2): Major amino acid content in ovary of different maturity stages in female *Trachinotus ovatus* (g/100g protein) dry weight.

Amino acids	Maturity stages						Correlation coefficient R^2
	immature	mature	nearly ripe	ripe	spawning	spent	
Aspartic acid(As)	6.928	5.433	3.612	3.248	4.396	4.933	0.857 *
Threonine(Th)	4.413	3.722	2.030	2.420	2.548	2.949	0.778 *
Serine(Se)	3.938	3.762	3.060	2.486	2.817	2.666	0.532 #
Glutamic acid(Glu)	5.157	6.928	6.279	7.792	8.190	7.666	0.201 #
Proline(Pr)	1.950	2.056	2.486	4.115	2.959	1.962	0.780 *
Glycine(Gly)	2.342	2.437	2.511	1.777	2.428	2.751	0.599 #
Alanine(Al)	2.621	2.712	3.093	4.736	3.659	3.171	0.687 #
Cystine(Cy)	0.026	0.030	0.038	0.122	0.266	0.091	0.132 #
Valine(Va)	1.940	2.008	3.213	3.436	2.743	2.577	0.904 *
Methionine(Me)	0.936	1.213	1.271	2.111	1.200	1.455	0.628 #
Isoleucine(Iso)	1.837	1.976	2.764	2.981	2.229	2.830	0.648 #
Leucine(Le)	2.466	2.922	3.344	4.017	3.765	3.820	0.484 #
Tyrosine(Tyr)	1.388	1.430	1.906	1.922	2.057	1.401	0.783 *
Phenylalanine(Ph)	2.031	2.154	2.239	2.328	2.890	2.575	0.001 #
Histidine(HI)	1.198	1.351	1.876	2.016	1.785	1.615	0.850 *
Lysine(Ly)	3.746	3.988	4.397	3.641	3.584	4.374	0.045 #
Arginine(Ar)	2.675	3.249	4.026	4.827	5.096	4.170	0.542 #

* Significant correlation at $P < 0.05$

\# Insignificant correlation at $P > 0.05$.

Total lipids and Fatty acids in ovaries of *Trachinotus ovatus:*

I- Total lipid:

Total lipid content of ovaries in female *Trachinotus ovatus* reached the minimal value of (7.868 ± 1.081 % of ovarian dry weight) at immature stage. The value of total lipid increased progressively to reach a maximum value of 14.021 ± 3.697 % at nearly ripe stage, followed by a value of 12.519 ± 1.921 % at ripe stage. Ovarian total lipid values were significantly correlated and approximately following the same manner of the GSI values at different maturity stages (Table 3 and Figure 2).

II- Ovarian fatty acids:

The fatty acids with high concentration present in *Trachinotus ovatus* ovary during different maturity stages were **palmitic acid** (16:0), **margaric acid** (17:0) and **oleic acid** (18:1), while the fatty acid with low concentration present was **pentadecanoic acid** (15:0). Other wise, ovarian fatty acids concentrations in the present study were insignificantly correlated with GSI values of different maturity stages.

The measured values of **myristic** (14:0), **palmitic** (16:0) and **stearic** (18:0) fatty acids reached the maximum values of 5.046, 31.577 and 8.852 % respectively at spent stage. The minimum values of those acids were 1.186, 21.710 and 4.789 % respectively at nearly ripe stage (Table 4).

Pentadecanoic (15:0) and **archidonic** (20:4) fatty acids measured values were fluctuated in relation to different maturity stages. At ripe stage the maximum values were 1.164 and 3.726% respectively. The minimum value of pentadecanoic acid was 0.684 % at nearly ripe stage. While, archidonic acid was reached the minimum value of 1.457 % at spawning stage (Table 4).

Palmitoleic (16:1) and **linolenic** (18:3) fatty acids reached the maximum value of 8.969 and 2.242 % respectively at spawning stage. While, the minimum value of palmitoleic acid was 5.415 % at maturing stage and the minimum concentration value of linolenic acid was 0.651 % at spent stage (Table 4).

Measured values of **margaric acid** (17:0) were fluctuated in relation to different maturity stages recording the minimum value of 6.592 % at spent stage. While it reached the maximum value of 22.805 % at nearly ripe stage (Table 4).

Concentration values of **eicosapentaenoic** (18:1) and **Oleic** (20:5) fatty acids recorded the maximum values of 5.493 and 27.772 % respectively at spent stage. Oleic acid recorded the minimum value of 20.437 % at ripe stage. At spawning stage the minimum value of Eicosapentaenoic acid was 0.747 % (Table 4).

Measured values of **linoleic acid** (18:2) reached the minimum of 3.357 % at spent stage. While, it increased at immature, nearly ripe and spawning stages reaching maximum value of 7.311 % at the immature stage (Table 4).

The recorded values of **gadoleic acid** (20:1) were fluctuated in relation to different maturity stages. The minimum recorded value was 0.912 % at nearly ripe stage. While the maximum recorded value was 1.438 % at mature stage (Table 4).

Table (3): Total lipid content in ovaries at different maturity stages of female *Trachinotus ovatus* (conc. %) in relation to gonadosomatic index (GSI) values.

Maturity stages	G.S.I.	Ovarian total protein			
		Minimum	Maximum	Average	± SD
Immature (whole year)	0.750	6.428	8.954	7.868	1.081
Mature (whole year)	1.080	7.955	11.024	9.784	1.260
Nearly ripe (April -mid May)	4.010	9.876	18.882	14.021	3.697
Ripe (late May to early Aug.)	4.240	9.378	13.796	12.519	1.921
Spawning (mid Aug. to mid Oct.)	2.010	6.679	10.827	9.350	1.798
Spent (Nov. & Dec.)	0.700	8.291	12.583	10.387	1.770

Significant correlation coefficient (r = 0.860 at p : 0.028)
number of samples (n = 9)

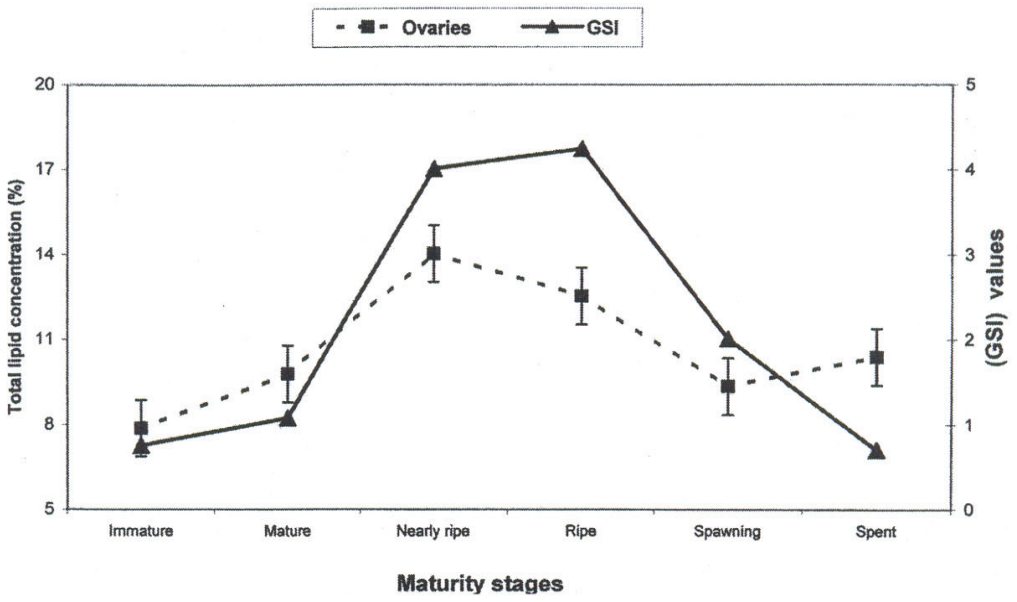

Figure (2): Total lipid content of ovaries in different maturity stages of female *Trachinotus ovatus* in relation to gonadosomatic index values (GSI.

Table (4): Major fatty acids content in ovary at different maturity stages in female *Trachinotus ovatus* (conc. %).

Fatty acids	Maturity stages					Correlation coefficient R^2
	Immature	Mature	Nearly ripe	Ripe	Spawning	Spent	
Myristic acid(14 :0)	1.730	2.707	1.186	3.202	3.270	5.046	0.355 #
Pentadecanoic acid(15 :0)	0.964	1.142	0.684	1.164	0.785	1.139	0.313 #
Palmitic acid(16 :0)	24.542	27.242	21.710	29.141	23.019	31.577	0.273 #
Palmitoleic acid(16 :1)	6.527	5.415	8.210	6.521	8.969	6.551	0.378 #
Margaric acid(17 :0)	21.528	17.343	22.805	16.594	20.740	6.592	0.374 #
Stearic acid(18 :0)	6.152	7.910	4.789	6.405	5.042	8.952	0.591 #
Oleic acid(18 :1)	22.507	22.504	26.180	20.437	26.158	27.772	0.237 #
Linoleic acid(18 :2)	7.311	6.768	7.184	5.240	6.446	3.357	0.142 #
Linolenic acid(18 :3)	1.898	1.354	2.166	1.747	2.242	0.651	0.520 #
Gadoleic acid(20 :1)	1.253	1.438	0.912	1.164	1.123	1.038	0.478 #
Arachidonic acid(20 :4)	2.875	2.792	2.052	3.726	1.457	1.831	0.298 #
Eicosapentaenoic acid(20 :5)	2.712	3.384	2.121	4.658	0.747	5.493	0.105 #

insignificant correlation at P> 0.05

DISCUSSION

In the present results total protein content in ovaries of *Trachinotus ovatus* is fluctuated in relation to different maturity stages recording maximum value at immature stage and minimum at spawning and spent stages. The maximum value of protein content at this stage may considered as energy source needed for the development of immature ovary as indicated by Ronnested *et al.* (1999) whom concluded that when developing egg and larvae of European sea bass (*Dicentrarchus labrax*) were maintained in filtered sea water the free amino acids appeared to be a significant energy substrate during the egg stage and the early yolk–sac stage. Amino acids form of proteins seemed to be mobilized for energy in the last part of yolk-sac stage.

In the present study, the ripe ovary exhibited a maximum content of alanine. The maximum content could be related to the maximum requirement of energy for the ripening of the fish. In agreement with the present results, Kim (1997) concluded that aquacultured *Oncorhynchus mykiss* are not much different from those of other rapidly growing farm animals. He found that rainbow trout was utilized either a dispensable amino acids mixture or alanine alone as effectively as casein as energy source.

In the present study seven amino acids (proline, alanine, valine, methionine, isoleucine, leucine and histidine) exhibited the same trend, being increased significantly in ripe ovary. This was followed by a significant decrease in both spawning and completely spent ovaries. The increase in these amino acids at ripe ovaries may be related to the importance of them in ripening process. In agreement with those results, Srivastava *et al.* (1995) concluded that in cultured and wild Atlantic salmon (*Salmo salar*) there was an increase in the free amino acid pool throughout the fish development. Decreased values in both total protein content and GSI value was detected during the spawning period due to the shedding of eggs.

Methionine and cystine amino acid contents in ovary of *Trachinotus ovatus* reach the maximum values in ripe and spawning stages. These contents implicate requirements for taurine (methionine and cystine), which was not synthesized in the fish body as indicated by Jacobsen and Smith (1968). Also, taurine was the most abundant amino acid which represents about 50% of the intracellular free amino acids in the ventricles of eel, flounder and brown trout (Vislie, 1983). The vital role of taurine in numerous physiological functions is more clearly elucidated for the human infant (Stapleton *et al.*, 1998). The role of this amino acid in fish nutrition remains to be investigated (Kim and lall, 2000).

Gunasekera and De-silva (2000) stated that porline and taurine are physiological amino acids. Huxtable (1992) reported that a number of functions including osmoregulation have been attributed to taurine. Osmoregulation is one of the most important functions in fishes (Conceicao *et al.*, 1997).

In the present result, insignificant correlation of arginine content with GSI values and highly significant correlation of threonine content with maturation stages were recorded. Barlongan (1991) studied the requirement of arginine and threonine for juveniles of milk fish and concluded that these values corresponded to 5.25 % arginine and 4.5 % threonine when expressed as a percentage of dietary protein.

In present work lysine amino acid reached the minimum content in the spawning ovary. The maximum content of lysine may be used for growth of the maturing fish and give requirement of energy and protein throughout the ripe and spawning period. Zarate and Lovell (1997) concluded that protein – bound lysine is more efficiently utilized for growth than free lysine in practical type diets for young catfish.

Serine amino acid in the present study reached minimum value in the ripe ovary of *Trachinotus ovatus*. This decrease in serine content may be related to the ovulation process as in trout fish. Coffman and Goetz (1998) described a set of ovarian proteins called trout ovulatory protein as a heat and acid stable serine protease inhibitor. This inhibitor is uniquely produced by the ovary and secreted into the coelomic fluid to act as protease inhibitor following ovulation.

In the present results glutamic acid contents reached maximum value in ripe and spawning ovary. This increase may be related to the oocyte ripening process. Yang *et al*. (1999) concluded that the intracellular concentration of glutathione (as glucocorticoides) directly inhibit the meiotic but not cytoplasmic maturation of big oocytes in vitro. This inhibitory effect is not mediated through a decrease in the level of intercellular glutathione .

In the present study the proline content reached maximum value in the ripe and spawning ovaries. The increase in glutamic acid and proline may be related to maturation, recovery and growth of cells (Asta *et al.* 1999). These authors concluded that in complete growth medium the full recovery of cell volume require several hours and is neither associated with an increase in cell K+ nor hindered by bumetande but depends on an increased intracellular pool of amino acid. The highest increase is exhibited by natural amino acid substrates of transport system A, such as glutamine and proline, and by the ionic amino acid glutamate.

Lipids are needed as a source of energy and to maintain the structure and function of cell membranes. They also play an important role in buoyancy control in some fishes (Ackman and Eaton, 1970).

Ovarian total lipid content in the present work was highly significantly correlated with GSI values. The maximum ovarian total lipid content was recorded in nearly ripe stage. Similar results were reported by Rajasilta (1992) stated that in Baltic herring (*Clupea harengus membras*) the fat content and condition factor were positively correlated with gonad weight, which could indicate that the maturation rate is dependant on fish condition. The fish which feed well mature at higher rate and produce larger gonads than those which feed less well. However the early spawners had higher gonadosomatic indexes and also higher fat content than the late spawners.

Ramadan (2002) reported that, the fat content was affected by maturation and the depletion of fat reserve in muscles accompanied by a rise of fat content in gonads, which may be due to fat transfer from muscles to gonads during the fish breeding season.

In the present study, concentrations of myristic acid (14:0), stearic acid (18:0) and linoleic acid (18:2) were fluctuated in relation to different maturity stags. Variable concentrations of these fatty acids may be determined by the requirements of the fish body owing to each fatty acid role in development of the fish as concluded by Gallagher *et al*. (1998).

Present study indicted that at the beginning of spawning period palmitoleic acid (16:1) and linolenic acid (18:3) reach maximum content, while margaric acid (17:0) maximum value was recorded at nearly ripe stage. These findings could be explained by Pernet *et al*. (2002) who concluded that fatty acids and lipids greatly accumulated just prior to spawning in *Renilla koellikeri*. The subsequent decrease of lipid and fatty acid contents probably resulted from loss due to spawning.

In *Trachinotus ovatus*, the fatty acids with high concentration present in different maturity stages were palmitic acid (16:0) and oleic acid (18:1), while those with low concentration was pentadecanoic acid (15:0) and gadoleic acid (20:1). Variable concentrations of fatty acids were determined by the requirements of the fish body owing to each fatty acid role in development of the fish as concluded by Gallagher *et al*. (1998).

In the present results the archidonic acid (20:4) reaching the maximum

concentration in ripe ovary. These results are related to the nutritional significance of archidonic acid requirements in *Trachinotus ovatus.* Present study supports the result of Gruff *et al*. (1995) who reported that In many animals archidonic acid is an important precursor of prostaglandin's which have important regulatory roles in the body including vasodilation, platelet aggregation and perhaps osmoregulation. Archidonic acid is also an important constituent of phospholipids including phosphotidylinositol as indicated by Gallagher *et al.* (1998).

In *Trachinotus ovatus* ovary, the concentration of archidonic acid gains no significant correlation with the fish maturation. Similar results were indicated by Karitaranta and Linko (1984) found no significant influence of fish maturation on the archidonic acid content of rainbow trout *Oncorhynchus mykiss* (Walbaum) and Baltic herring roe, but archidonic acid increased as the maturity index values increased. The maximum content of archidonic acid in *Trachinotus ovatus* ovary was detected in ripening period. This could be explained by Gallagher *et al.* (1998) who stated that a dietary requirement for archidonic acid in brood stock diets could be a problematic to culturists since no good dietary source of archidonic acid exists currently. Archidonic acid may be needed to produce the phospholipids, especially phosphotidylinositol for incorporation into eggs as indicated by Gunasekera *et al.* (1995).

Present results indicated that eicosapentaenoic acid (20:5) fluctuated in relation to different maturity stage of *Trachinotus ovatus* ovary. Those concentrations may consider as variation in a dietary requirement of eicosapentaenoic acid. The deficiency of this fatty acid had a direct effect on visual performance of fish as indicated by Bell *et al*. (1995). They reported that eicosapentaenoic (EPA) and clupanodonic (22:5 n3) acids were substituted for decosahexaonoic acid (22:6 n3) in eye phospholipids when there was a dietary deficiency.

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