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FLUCTUATIONS IN FAT AND WATER CONTENTS OF TWO SPECIES OF SERRANID FISHES IN THE EGYPTIAN MEDITERRANEAN WATERS.

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ABSTRACT

The study of fluctuations in the fat and water contents of **Epinephelus aeneus** and **Epinephelus alexandrinus** revealed that the amount of hepatic lipids was higher than muscle lipid.

In different fish species, fat content shows individual variations and young fish usually contains lower fat content than adult. However, for both species under study, it was observed that fat content in the muscle of youngs was higher than in adults, although water content was generally higher in the youngs than adults.

This study also revealed the presence of an inverse relationship between fat and water content for both species in muscle and liver. The present work showed that the amount of hepatic fat is lower in pre-spawners and spawners.

The amount of hepatic fat in **Epinephelus alexandrinus** is less than in **E. aeneus**, while flesh fats are higher in **E. alexandrinus** than in **E. aeneus** in both youngs and adults.

INTRODUCTION

In fish, as in many other vertebrates, fat is stored to supply energy during starvation or reproduction (Love 1957; Tarr 1960; El-Maghraby et al, 1972). Various fishery biologists, have considered visceral fat as an indication of the well being of the fish. Fat is usually stored in the muscles and liver of fish. Some fish tend to store fat in the muscles more than in the liver (fatty fish). Others store fat in the liver (lean fish).

Monthly variations in the fat of muscles and liver occur in various fish species in function of reprodctive cycle, growth or ecological conditions under which the fish lives. These variations are of prime importance in the general condition of the fish. Hence, the importance of such study for various fish species.

In the present study, variations in the fat content of flesh and liver,

together with the water content are followed in order to explain the metabolic changes in their biochemical constituent in the different seasons of the year.

The relation of the amount of fat with the sex is not considered, because it is difficult to identify visually the sex in these hermaphrodite fishes (the sex is identified only by histological studies in the protogynous hermaphrodite serranid fishes).

MATERIAL AND METHODS

Monthly samples of **Epinephelus aeneus** and **Epinephelus alexandrinus** were collected from professional fishermen at Alexandria fish market. Sampling lasted form January 1976 to March 1977. Total fat and water content were determined for flesh (muscles) and liver. From the muscles (on the flank region, white muscle only) and liver, a piece of about 10 gram in weight was taken for fat and moisture analysis. Then dried in the oven at 55°C till constant weight. Moisture was determined as the difference in weight before and after drying.

The method of Soxhelt (Floch et al, 1956) for fat extraction, being found time consuming for serial investigations, was not used. The adopted Soxhelt method for serial fat estimation as described by Wimpenny (1938) was used in the present study. The essential difference between the two methods consists in that, by the method of Soxhelt extraction, the fat content is directly established, when the extraction has taken place, and upon the evaporation of the solvent, by weighing the substance in the container. According to Wimpenny (1938) the fat content results from the difference between the two weights of the analysed substance i.e. before and after extraction.

In the present study, the method of Wimpenny (1938) is slightly modified, by replacing the glass extraction tubes with tightly wrapped filter papers containing the materials. The dried substance remaining after the water determination, was crushed into powder and a quantity of 0.5-1.0 gram was taken. This was then put in a tightly wrapped filter paper (dried also to constant weight). The weight of the filter paper used should be known. The weight of the filter paper plus the material was then obtained using a sensitive balance (up to 0.0001 gram). The difference between the last weight and the weight of the filter paper, gives the weight of the material before extraction. The filter paper containing the material was then put in the Soxhelt apparatus. The extraction was carried out with a mixture of chloroform and methanol (2:1). This proceeded for 24 hours. The wrapped filter papers were again dried at a temperature of 80°C to constant weight. The difference between the last weight and the weight of the filter paper, gives the weight of the material after extraction. The weight of the extracted fat is the difference in the weight of the material before and after extraction. The extracted fat was then expressed as percent of the

fresh weight of the material.

OBSERVATIONS

I- For **Epinephelus aeneus**

1- Fish lipids (Table 1)

We can see that the amount of fat fluctuates between 0.43% and 1.59% (mean = 0.93%) for the youngs. For the adults, muscles fat varies between 0.39% and 1.15% (mean = 0.69%). This shows that the amount of muscle fat is higher in the youngs than in the adults. From table 1 and figure 1, we can see that two drops in the content of the flesh are present, one in June (prespawning) and the other in October (post-spawning). The maximum fat content in the youngs, is in winter (January and February).

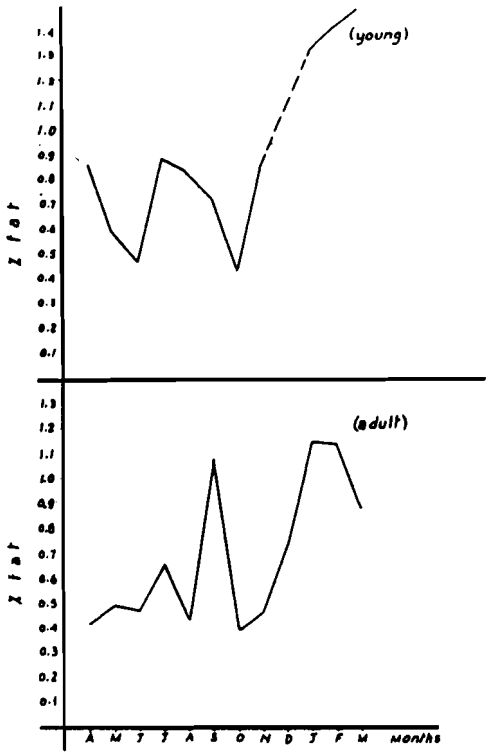

Fig. 1. Monthly variation of fat content in the body muscles of young and adult **E. aeneus** in Alexandria waters (1976-1977).

(TABLE 1)

Monthly variation of fat and water content in the body muscles of young and adult

Epinephelus aeneus in Alexandria waters.

(1976 - 1977)

Month		April 1976	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Jan. 1977	Feb.	March
		(3)+	(2)	(4)	(5)	(3)	(4)	(5)	(2)		(2)	(3)	(1)
Mean %	F	0.87	0.59	0.47	0.89	0.84	0.73	0.43	0.86	-	1.43	1.52	1.89
		(3)	(2)	(4)	(5)	(3)	(4)	(5)	(2)		(2)	(3)	(1)
Young	W	78.96	78.16	78.90	77.24	77.30	77.42	77.76	77.65	-	77.70	78.03	76.70
		(5)	(11)	(4)	(4)	(3)	(5)	(9)	(5)	(7)	(10)	(8)	(9)
Mean %	F	0.42	0.49	0.47	0.66	0.43	1.08	0.39	0.46	0.74	1.15	1.14	0.88
		(5)	(11)	(6)	(4)	(5)	(5)	(9)	(6)	(7)	(11)	(8)	(9)
adult	W	78.87	77.93	77.45	77.93	77.70	76.54	77.51	77.80	77.33	77.44	78.36	77.16

\+ Number of fishes
F % fat
W % water

The fat content decreases thereafter till it reaches minimum in June after which a notable rise is obtained in July. Another drop is noticed in October. In November, the fat content returns to its original value. In January, February and March, the fat contnet of the flesh is nearly double its normal amount in the other months of the year. In the adults, the maximum fat content is in September and the minimum in October.

In both youngs and adults, the higher fat content is observed in winter months. The decrease in October and November is due to exhaustion of the fish body after spawning which usually takes place from June to August.

The high amount of fat in winter shows that the fish does not stop feeding in winter.

Concerning the monthly variations in the water content (Fig.2), we

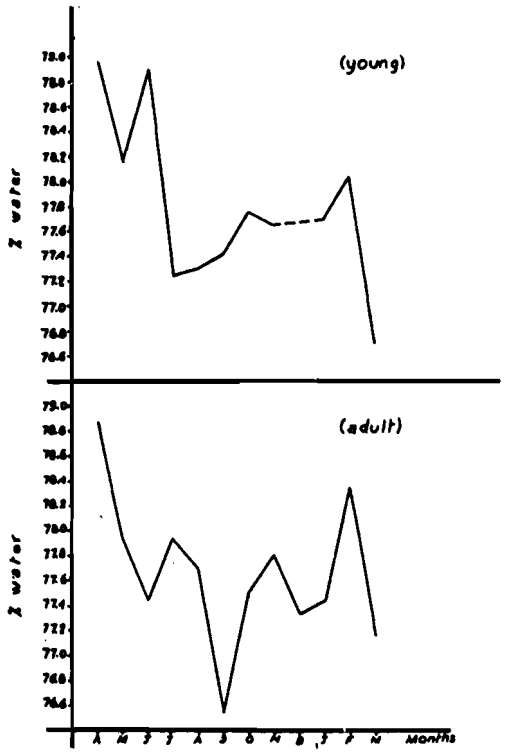

Fig. 2. Monthly variation of water content in the body muscles of young and adult *E. aeneus* in Alexandria waters (1976-1977).

Table 2
Variation of fat and water contents with length in the body muscles of Epinephelus aeneus in Alexandria waters (November, 1976).

Total Length(cm)	30.00	35.0	42.0	44.0	46.00	63.00	66.00	80.00
% of Fat	00.32	01.4	00.4	-	00.97	00.64	00.02	00.24
% of Water	79.40	75.9	79.3	79.2	78.30	75.80	77.10	77.10

notice that inverse relationship between water content and fat content can be detected. In spring and early summer, the amount of water is high in both young and adult fish, while fat content is lower. On the other hand, in winter, the amount of fat content is high and the water content is low.

Study of variation of fat and water content in fish flesh with length, was based on fishes of different length groups caught in November (rest stage). According to the data given in table 2, it is apparent that the fat content decreases with length.

Concerning variations in water content, it seems that water varies between 75.8% and 79.4%. It is generally higher in small sizes than in big sizes.

2- Hepatic lipids

Amount of fat in the liver is higher than in muscles. In the liver percent of lipids varies between 5.37% to 17.40% (liver weight) in young fish. For the adults, lipids amount from 11.09% to 15.05% (liver weight). In flesh, lipids content varies between 0.43% to 1.59% for young and 0.39% to 1.15% in the adults. Thus, hepatic fat is higher than muscular fat. We notice here that the amount of hepatic fat in the youngs is lower than in the adults.

From table 3 and fig. 3, fat in the adult liver does not show much fluctuations, it is lowest in the period from June to September. This corresponds to the pre-spawning and spawning periods. In October and November, the hepatic fat shows an increase. In winter and early spring months (February and March) the amount of hepatic lipids decreases. If we compare this curve, fig.3 with that of hepato-somatic index (fig.4), we cannot find a conclusive relation between both. This is due to the fact that the variation in the hepato-somatic index is due to variations in other constituents of the liver as well. However the decrease in the amount of HSI in August corresponds to the time of lowest values of lipid content. In September, hepato-somatic index increases, while the percentage of fat is low, this indicates an increase in other constituents of the liver such as protein and glycogen. In November, the percentage of hepatic

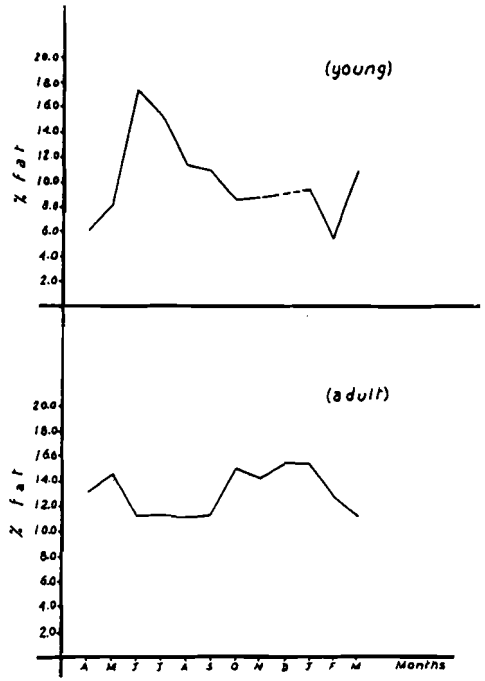

Fig. 3. Monthly variation of fat content in the liver of young and adult **E. aeneus** in Alexandria waters (1976-1977).

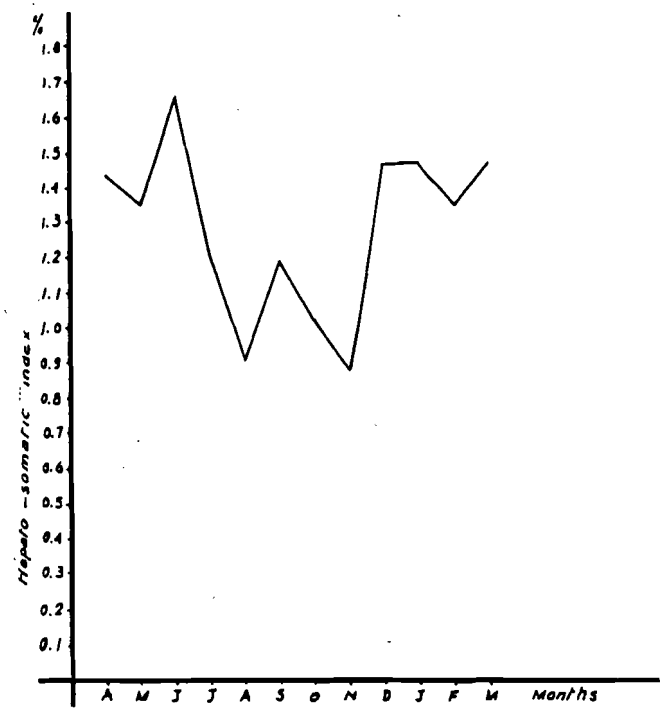

Fig. 4. Monthly variation of hepato-somatic index of **E. aeneus** in Alexandria waters (1976-1977).

(TABLE 3)

Monthly variation of fat and water contents in the liver of young and adult

Epinephelus aeneus in Alexandria waters

(1976 - 1977)

Month		April 1976	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Jan. 1977	Feb.	March
		(3)+	(2)	(4)	(4)	(3)	(3)	(6)	(2)		(2)	(2)	(1)
Mean %	F	6.14	8.22	17.40	15.29	11.33	10.88	8.53	8.76	-	9.31	5.37	10.88
		(3)	(2)	(4)	(4)	(3)	(4)	(6)	(2)	-	(2)	(3)	(1)
Young	W	73.57	70.17	72.92	66.80	68.47	69.03	64.08	67.90		67.70	67.00	64.10
		(5)	(12)	(7)	(3)	(5)	(5)	(9)	(6)	(6)	(10)	(6)	(9)
Mean %	F	13.19	14.66	11.29	11.38	11.09	11.39	11.05	14.32	11.52	11.45	12.91	11.41
		(5)	(12)	(8)	(4)	(6)	(5)	(9)	(6)	(6)	(10)	(6)	(10)
adult	W	65.71	65.08	65.90	68.68	70.10	63.58	65.16	64.82	66.05	67.96	65.88	65.26

\+ Number of fishes
F % fat
W % water

fat is high, while the HSI is low. This suggests a decrease in the other biochemical constituents of the liver especially glycogen.

It is known that protein constituents of the liver do not undergo significant variations (El-Sayed, 1979). In December and January, both of hepatic fat and HSI are high. This is in accordance with increase in the muscular fat which shows the well being of this fish in winter months. It seems that this fish feeds in winter time. Variations of fat and water content with length is also based on fishes caught in November, which represents the rest stage, table 4. From the table, if we exclude the value of lipids for 44.0 cm length group, we can see that the amount of hepatic lipids increases with length till it reaches 46.0 cm, after which length, hepatic liver decreases with fish length.

Concerning the variations in water content, table 4 shows that it varies between 57.6% and 74.0%. It is higher in fishes less than 44.0 cm, than those above this size.

Table 4
Variation of fat and water contents with length in the liver of Epinephelus aeneus in Alexandria waters (November, 1976).

Total Length(cm)	30.00	35.00	42.00	44.00	46.00	63.00	66.00	80.00
% of Fat	07.52	09.99	14.11	06.16	19.77	16.54	18.40	10.60
%of water	68.30	67.50	68.70	74.00	61.10	60.60	57.60	66.90

II-For **Epinephelus alexandrinus**

1- Flesh lipids

From table 5 and fig. 5, the amount of fat in this fish varies between 0.79% to 2.31% (mean = 1.56%) in the flesh of the young. In the flesh of the adult, it fluctuates between 0.63% to 1.91% (mean = 1.26%). This shows that the amount of flesh fat is higher in the youngs than in the adults. Here we can see three drops in the muscular fat of adult fish throughout the year, first drop in May, the second one in August and the third in December. Two peaks are observed, the first in June / July and the second in October. In winter season, the amount of fat is low.

This fish is known to spawn in the period from May to August. This explain the drop in the fat content in October, which is due to exhaustion of the body in the time of spawning. In December, the drop in the amount of fat is due to a decrease in the avaliable food in that month and a decrease

(TABLE 5)

Monthly variation of fat and water contents in the body muscles of young and adult

Epinephelus alexandrinus in Alexandria waters

(1976 - 1977)

Month		April 1976	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Jan. 1977	Feb.	March
		(1)+	(2)	(5)	(8)	(3)	-	(9)	-	(1)	-	-	(2)
Mean	F	1.11	0.79	0.95	1.61	1.70	-	2.17	-	1.81	-	-	2.31
%													
		(1)	(2)	(4)	(9	(3)	-	(9)	-	(1)	-	-	(2)
Young	W	79.63	76.91	78.72	76.17	76.03		75.81		76.50			75.55
		(10)	(20)	(17)	(21)	(17)	(22)	(18)	(10)	(22)	(17)	(25)	(12)
Mean	F	1.07	0.63	1.86	1.91	1.11	1.57	0.91	1.08	0.99	1.35	1.31	1.52
%													
		(9)	(21)	(18)	(21)	(20)	(22)	(20)	(12)	(24)	(18)	(25)	(12)
adult	W	78.46	78.40	77.99	75.96	77.54	76.22	77.76	77.01	77.56	77.31	78.20	77.14

\+ Number of fishes
F % fat
W % water

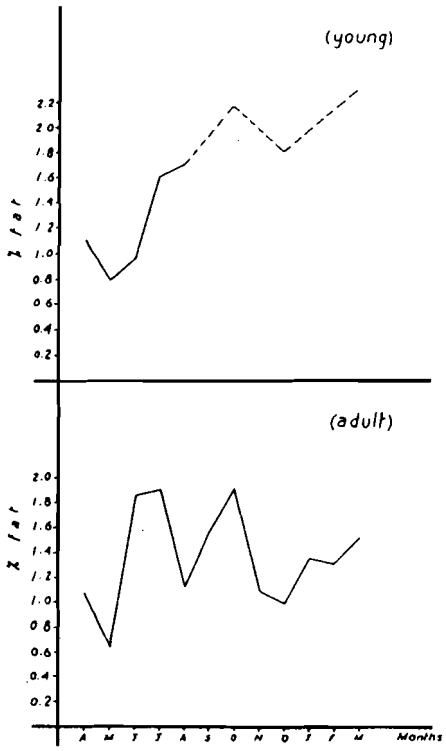

Fig. 5. Monthly variation of fat content in the body muscles of young and adult **E. alexandrinus** in Alexandria waters (1976-1977).

in the activity of the fish.

From the curve showing the fluctuations in water content (fig.6), we can see that water is maximum in late winter and early spring, this corresponds to a decrease in the muscular fat. Here also we notice a reverse relationship between fat and water content.

Variation of fat and water content with length is followed for fish caught in November, which represents the rest stage of this species. From table 6, we can see that lipid content increases till length of 44.0 cm, after which it decreases sharply. Water content varies between 66.7% and 79.6%. It does not show any variation with length.

2- Hepatic lipids

Amount of lipids in the liver of young varies between 3.97% and 11.03% (mean = 7.025%), while in the adults, it varies between 5.80% and 10.39%

Table 6
Variation of fat and water contents with length in the body muscles of Epinephelus alexandrinus in Alexandria waters (November, 1976).

Total Length (cm)	25.00	27.00	28.0	29.00	30.0	34.00	36.00	42.0	43.00	44.00	45.00	46.00
% of Fat	00.39	01.27	-	00.69	-	01.35	00.78	02.6	01.29	01.23	00.25	00.96
% of water	79.60	77.40	78.9	78.20	73.9	77.40	-	66.7	77.00	77.90	78.50	79.20

(TABLE 7)

Monthly variation of fat and water contents in the liver of young and adult

Epinephelus alexandrinus in Alexandria waters

(1976 - 1977)

Month		April 1976	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Jan. 1977	Feb.	March
		(1)	(2)	(3)	(6)	(3)	-	(7)	-	(1)	-	-	(1)
Mean	F	7.33	3.97	5.93	8.65	7.99		11.03		10.64			9.33
%													
		(1)	(2)	(4)	(6)	(3)		(8)		(1)			(1)
Young	W	71.70	71.50	74.83	68.38	70.83		64.70		64.30			65.35
		(11)	(17)	(16)	(16)	(16)	(19)	(15)	(11)	(21)	(16)	(22)	(12)
Mean	F	6.74	7.08	5.80	9.92	7.82	8.80	10.39	8.74	8.07	8.28	10.29	8.14
%													
		(10)	(20)	(18)	(21)	(16)	(19)	(16)	(12)	(24)	(17)	(23)	(13)
adult	W	69.77	71.32	69.93	69.61	71.19	71.01	66.31	68.52	66.79	66.36	66.97	67.74

\+ Number of fish
F % fat
W % water

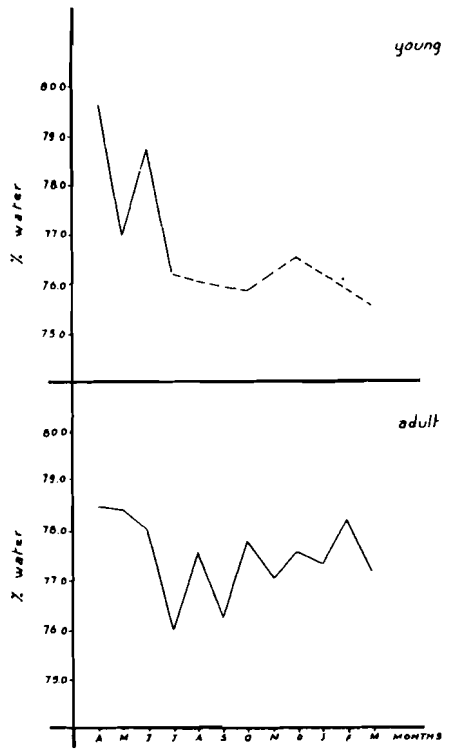

Fig. 6. Monthly variation of water content in the body muscles of young and adult **E. alexandrinus** in Alexandria waters (1976-1977).

(mean = 8.34%). This shows that hepatic lipids are slightly higher in the adults than in the youngs. Flesh fat varies between 0.79% and 2.31% in youngs and 0.63% to 1.91% in adults. Thus, we can see that the amount of fat in the liver is higher than in the muscles. Table 7 and fig. 7 show the monthly variations of fat content. From the figure, we can see that in July, October and February the hepatic fat is maximum. Three drops can be noticed, in June, August and December. By comparing fig. 7 with fig.8 showing the monthly variation of hepato-somatic index of **E. alexandrinus,** we can notice the following

- In June, a decrease in hepatic fat occurs, while HSI increases.
- In July, an increase in percent fat is observed and a decrease in HSI is noticed.
- In August and September, both HSI and hepatic lipids show a decrease.
- In October, the HSI and hepatic lipids also increase.
- In January, the hepatic lipids are still low, but the HSI is very high.

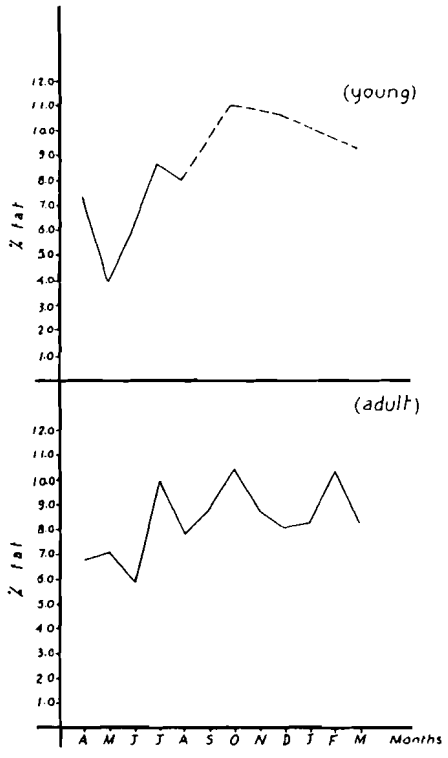

Fig. 7. Monthly variation of fat content in the liver of young and adult **E. alexandrinus** in Alexandria waters (1976-1977).

From this, we can see that the fluctuations in the fat of the liver do not affect the hepato-somatic index. Whereas in some cases, the amount of fat and the HSI decrease simultaneously, in others a decrease in HSI corresponds to an increase in the fat content. This suggests that the other biochemical constituents affect also the weight of the liver. This observation has been also noticed in the previous species studied, **E. aeneus.**

Concerning the variation of fat and water content with length (table 8), it is observed that lipids vary between 4.23% and 11.91%. No variation with length is noticed. Water contents vary between 63.1% and 74.1%, it is generally lower in fishes less than 44.0 cm length group than above that size.

DISCUSSION

Study of biochemical composition of fish is now of the current problems in fishery biology. This is due to the lack of knowledge in this respect

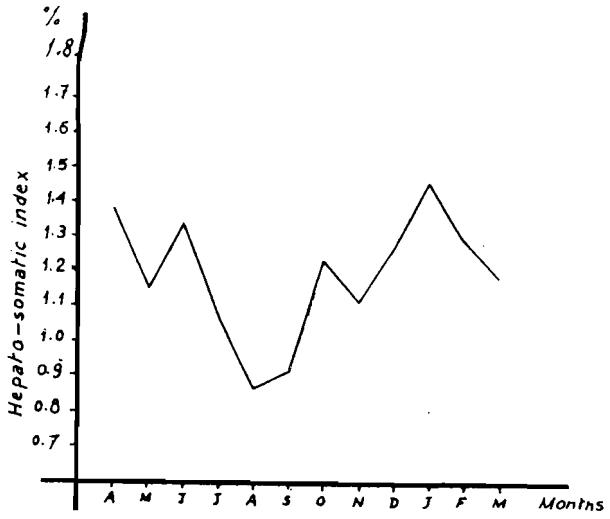

Fig. 8 . Monthly variation of hepato-somatic index of **E. alexandrinus** in Alexandria waters (1976-1977).

for various fish species. Although several early investigators worked in this field, but conclusive results cannot be taken from their works, due to insufficient number of samples (Atwater, 1888; El-Saby, 1934,1937). A balanced picture of the biochemical composition of fish as a whole, has not so far been achieved. Fishes were only analysed from the stand point of food technology or nutrition. Data from these papers are not of prime interest to the fishery biologist. From this, we can see the importance of such study at our local fish species. Data on the amount of fat in our local fishes are scanty. The study of variation of fat content in the fish is highly important in order to assess the fat metabolism in the fish body.

Fat undergo variations in function of ecological conditions and with the season. Various authors classify fishes into two large groups, concerning fat storing, thus we have fatty fishes, and lean fishes. Fatty fishes (Mullus type) are those which store their fat in the muscles, while lean fishes (Gadus type) are those which store their fat in the liver (Bougis, 1952; Love, 1975).

The present study reveals that for both species under investigation namely **E. aeneus** and **E. alexandrinus,** the amount of hepatic lipids is higher than muscle lipid. This shows that these species store their fat in the liver. **Epinephelus** spp. belong to the family Serranidae. Various authors came to the same conclusion concerning these fishes. El-Saby (1937) on **Morone labrax** found that muscle tissues of this species are poor in fat as compared to the liver which has a higher fat content. Stirling (1972) working on the same species came to the same conclusion.

Table 8
Variation of fat and water contents with length in the liver of
Epinephelus alexandrinus in Alexandria waters (November, 1976).

Total Length(cm)	25.00	27.00	28.00	29.00	30.00	34.00	36.00	42.00	43.00	44.00	45.00	46.00
%of Fat	11.65	10.73	07.58	08.51	04.23	06.91	-	11.91	08.97	11.09	07.30	07.26
% of water	65.60	66.30	71.90	68.50	64.00	63.10	74.10	69.20	70.50	68.50	69.00	71.50

Stansby (1962) divided fishes into different categories according to their lipid and protein contents. The present results show that both species studied fall into category A in Stansby's classification (1962), i.e. lipid in muscles are less than 5%.

In various fish species, fat content shows individual variations and young fish usually contains lower fat content than adult ones (Bogucki and Trzesinski, 1949; Krvaeic and Muzinic, 1950; Love, 1957; Mussacchia, 1959; Rao 1967, Love, 1970; Stirling, 1972).

The present study reveals that, contrary to what is known, that fat content in the muscle of the youngs is higher than in the adults for both species; although water content is generally higher in the youngs than in the adults.

Stirling (1972) have shown that in **Morone labrax**, mature fish have higher muscle lipid content than immature ones. Inter relationships of the main constituents of the flesh vary between species according to where the reverse lipid will be stored. In the muscle tissues of fatty fish, a reverse relationship between lipid and water exists, an increase in the proportion of one leads to a decrease in the other so that the sum will approximately be constant. The muscles of non fatty fish, behave differently in that a time lag occurs before this reverse relationship is listed.

Various authors spoke of a protein-water line in lean fish (Love, 1957; Dambergs, 1964), however they were not against the presence of fat water relationship for non-fatty fishes.

The present analysis shows the presence of an inverse relationship between fat and water for both species under study in both muscle and liver. We should mention that this relationship is poor and it seems to be masked by the protein-water relationship.

This explain the fact that although the amount of fat in immature fish muscles is higher than the adult, yet the amount of water is still higher in the young than in the adult. The revers fat-water relationship is more clear in the monthly values of fat and water.

Seasonal variations of biochemical constituents have been observed for various fish species. The relationship between fat and season is a complicated feature in fish physiology. Various authors claimed that the amount of fat in fish decreases in the spawning and postspawning periods and increases thereafter when the fish resumes its feeding activity. However, Love (1957) have shown that, there is no general applicable relation between fat and gonad development. Luhman (1953), found in the herring that fat reserving of spring spawner, were at their lowest immediately after spawning, because of some earlier depletion in the previous winter. The fat reserves of autumn spawners were not minimal

after spawning because fat was still needed for the winter ahead. Degree of ripeness therefore according to these authors is no indication of fat content, unless the spawning time of the species in known.

Brades and Dietrich (1953 b) have shown individual variations in the fat content of the fish body. This observation have been cited before by El-Saby (1934) on **Morone labrax** and Stirling (1972) on the same species.

The present study reveals the presence of seasonal variations in the amount of flesh and hepatic fat. Thus, a drop is noted in the muscle fat in post-spawners. Variation in fat content is parallel to the drop of the HSI in autumn, which shows that energy needed in spawning season is taken from stored fat in muscle and liver.

Bruce (1924); Channon and El-Saby (1932) working on fat metabolism of herring, have shown that fat stored in the body during the period of growth and feeding is the immediate source of energy expanded by the fish at the time of its spawning migration when no food is taken.

Black and Schwartz (1950) in their study on the fat distribution in the south African pilchard have stressed on the existance of correlation between the changes in fat content of muscles and the reproductive cycle. Bailey (1952) pointed out that in fishes like salmon and herring (fatty fish) storage and concentration takes place in the muscles, while in sardine, cod and shark it is in the liver. Chidambaran et al (1952) attributed the two peaks of fat accumulation in the Indian mackerel to the feeding activity. Hoar (1959) stated that the fat accumulates in various organs prior to maturation of gonads in many fish. According to Rao (1967) the grduai reduction of muscle fat during gonadal ripeness indicates the utilization of fat first by ovaries and later by the body during the spawning and post-spawning period. Liver, visceral and mesentrial fat contribute more towards the demands of ovarian maturity than the flesh. Luhman (1953) stated that factors like temperature, salinity and food are of equal importance on the accumulation and depletion of fat content as sexual maturity.

In **E. aeneus,** amount of fat is higher in water time than any other seasons of the year. This fish is known to be a lazy creature living in holes between rocks, it feeds on small fish and crustacea, getting near to its locality. It seems that in winter time, where the speed of movement of its prey is lowered, the availability of food increases. This fish seems therefore, not to stop feeding in winter. Hence the increase in the fat content in winter, this phenomenon is not observed for **Epinephelus alexandrinus** which is more active than the first species. For this fish, the amount of fat in winter time is low.

In these two species under study, it has been found that the amount of hepatic lipids in these fishes is higher than muscle lipids. The present analysis revealed that the amount of hepatic fat is lower in pre-spawning and spawners.

The increase of hepatic fat in autumn (post spawners) is a direct result of increased feeding activity. Since fat is deposited more in the liver than in the muscles. Rapid recovery exists in the liver than in the muscles. Fishes of family Serrandiae are known to have the liver and ovaries rich in protein and lesser in lipids and carbohydrates (Stirling, 1972). The contraversy between the variations in HSI and hepatic lipids might show that variations in protein content or carbohydrates are more effective on the whole weight of the liver than fat content. If the fat content increases and HSI increases, this means an increase in other constituents at a higher rate than the fats, which has as a result an apparent decrease of fat content.

The amount of hepatic fat in **E. alexandrinus** is less than in **E. aeneus,** while flesh fats are higher in **E. alexandrinus** than in **E. aeneus** in both youngs and adults.

For **E. aeneus,** flesh fat varies between 0.43% and 1.59% for youngs and between 0.39% and 1.15% for adults. Hepatic fat varies from 5.37% to 17.4% for youngs and from 11.09% to 15.05% for adults. For **E. alexandrinus,** flesh fat varies between 0.79% to 2.17% for youngs and between 0.63% to 1.91% for adults. Hepatic fat varies between 3.97% and 11.03% for youngs, and between 5.80% to 10.39% for adults.

This is in accordance with what was cited by El-Saby (1934); Mussacchia (1959) and Love (1957), who have shown variation in fat content between different species.

The increase of hepatic fat, for both species under study, in adults more than the youngs is in accordance with the results of various authors (El-Saby (1937); Mussacchia (1959) and Stirling (1972).

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