

**THE FAT-CONTENT
IN THE FLESH OF SOME CYPRINIDS**

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INTRODUCTION

The Cyprinids (Carp, Goldfish, Common Carp, etc.) are considered as one of the most important fish groups in the world. They are widely distributed in fresh water and brackish water. The fat content of fish is an important factor in determining its nutritive value. The fat content of fish is affected by many factors such as species, age, sex, season, and environment. The present study was conducted to determine the fat content in the flesh of some cyprinids. The fish were collected from the Nile River and the Mediterranean Sea. The fat content was determined by the gravimetric method. The results showed that the fat content of the fish varied from 1.5% to 3.5%.

ABSTRACT

Over the period from November 1968 to September 1969 the fat content in the flesh of *Labeo niloticus* and *Barbus bynni* of the Nozha-hydrodrome was estimated. In spite of individual variation, a clear monthly trend was observed, with high fat content in autumn and low values in spring, which coincide with the feeding activity of the fish, during the previous seasons.

The amount of fat in the flesh of both species increases with the increase of fish length, and the females are usually more fatty than males. Gonad maturation does not notably affect the amount of fat in the muscles. A wide range of variation in the fat content of both species was observed. However, within the same month and for the same length group, the amount of fat in the flesh of *Barbus bynni* was nearly double that of *Labeo niloticus*.

INTRODUCTION

The Cyprinids (*Labeo niloticus*, Forsk. & *Barbus bynni*, Forsk.) are considered as two of the most common Nile fishes. However, little work was carried out on the biology of these species. Furthermore, nothing is known about the nutritive value of these fishes. So, the aim of this work is to determine the fat content in the flesh of these two fish species, as well as to find the relation between the fat content and the fish length, sex and stage of maturity. These information are very important in biological studies, beside their value from the nutritive point of view.

MATERIAL AND METHODS

Beside the biological investigation carried out on the *L. niloticus* and *B. bynni* of the Nozha-hydrodrome, a biochemical analysis of the fat content in the flesh of these fishes was also made in the period from November, 1968 to September, 1969.

Large fishes of total length more than 30 cm. were taken in separate samples, while small fishes (<30 cm. T.L.) were taken in mixed samples (2—3 fishes together). The skin of the fish was carefully removed and a flesh sample of about 10 gm. was taken from the mid-dorsal region. The flesh sample was cut into small pieces and weighed in a petri-dish. The sample was then dried in an oven at 60—70°C, to a constant weight. The water content can be expressed as the difference in weight before and after drying.

For fat extraction, the Soxhlet method for serial fat estimation, as adopted by Wimpenny (1938), has been slightly modified. After crushing the dry substance into powder, about 0.7 gm. of the fine material was wrapped in a tightly closed filter paper and weighed with an analytical balance. The filter papers with their contents were put in a Soxhlet apparatus containing chloroform and methanol (2 : 1 — V. / V.). The filter papers were then dried to a constant weight and the fat content was calculated as the difference between the weight of the sample before and after fat extraction. The amount of fat is then expressed in percentage to the weight of the dry substance.

DISCUSSION OF RESULTS

I — LABEO NILOTICUS

The present investigation deals with the fat content in the flesh of *L. niloticus*, to establish its relation to the length, sex and stage of maturity, as well as to observe the variation of fat content during the different months. It has to be mentioned that the amount of fat in the muscles of *L. niloticus* varies from one fish to the other. The maximum value (23.00%) was established for a fish of 44 cm.T.L. and 856 gm. of weight, taken in August 1969, and the minimum value (7.00%) for a mixed sample of 22 cm. average length and 80 gm. average weight, sampled in December 1968. At the same time, the water content varies, but in an opposite direction to that of the fat content.

Also, it has to be mentioned that individual variation in the fat content of the flesh does exist between individuals caught in the same month, having the same length, sex and stage of maturity.

Monthly variation in the fat content:

The amount of fat in the flesh of *L. niloticus* varies from one month to the other. Table (1) shows the average monthly values calculated for different length groups. It is clear that the lowest value (8.50%) was recorded in April for fishes of less than 30 cm. T.L., and the highest value (19.0%) was recorded in August for fishes of 41-50 cm. length range.

During the period of investigation, some irregularities in the fat content were observed. However, the low values were recorded for samples taken in spring, while high values were for samples taken in summer and autumn.

The approximate estimate of the internal fat, made during the biological investigation of *L. niloticus* (Hashem, 1973) generally agrees in trend with the chemical estimate of the fat content in the fish flesh, except in December when a certain decrease of the internal fat was manifested in that month, while the fat content of the flesh remained at a high value. This means that the consumption of the stored up fat in winter goes at the expense of the intestinal fat in the first place, and only then of the fat in the flesh. This coincide with the finding of Morawa (1956) who pointed out that the greatest seasonal changes in the fat content occur in the internal organs, while changes in the flesh being rather smaller.

Fat content in relation to fish length:

Table (1) also contains the mean values of the fat content in the flesh of *L. niloticus*, showing the interdependence between the amount of fat and fish length. It is clear that, within the same month, the amount of fat established in the tissues of each length group differ one from the other. In December, for example, the smallest amount of fat (10.65%) was recorded for fishes smaller than 30 cm. T.L., and with the increase in length the amount of fat increased reaching maximal value (14.25%) in fishes larger than 50 cm.T.L. The same trend was also observed in January and to some extent in other months. This means that, in most cases, the fat content was found to be higher in larger fishes than in smaller ones. This can be explained by the intensive growth

Table (1) — Monthly variation of the fat content in the flesh of *L. niloticus* from the Nozha-hydrodrome according to different length groups (Number of samples between brackets)

Month	Length group (cm.)				General Average
	<30	31—40	41—50	>50	
November	10.83 (2)	14.30 (1)	12.25 (2)	14.70 (1)	12.53 (6)
December	10.65 (2)	12.05 (2)	12.79 (3)	14.25 (2)	12.47 (9)
January	11.40 (3)	11.45 (4)	12.70 (1)	13.85 (2)	12.04 (10)
February	8.70 (1)	11.95 (5)	12.62 (4)	12.60 (1)	11.96 (11)
March	11.70 (2)	11.20 (4)	12.50 (1)	—	11.53 (7)
April	8.50 (1)	11.06 (5)	12.30 (1)	—	10.87 (7)
May	—	8.60 (1)	10.0 (1)	—	9.30 (2)
July	—	14.4 (5)	—	—	14.4 (5)
August	—	12.0 (23)	19.0 (4)	—	13.0 (27)
September	—	9.1 (4)	11.8 (3)	—	11.7 (7)
Grand Average	11.70 (11)	11.78 (54)	13.61 (20)	13.92 (6)	

of smaller fish. Similar observations were also obtained with other fish species (Fage, 1920; Furnestin, 1943; Krvaric et al, 1950;.... etc).

Influence of sex and stage of maturity upon the fat content:

Beside the difference, which may exist between fishes of the same size, there may also occur some difference in the fat content of the muscles in fishes of different sexes, although having nearly equal lengths. Table (2) shows that the percentage of fat content in the females were higher than those recorded for the males. This may be due to differences required either by translocation or synthesis, to build up the organs of the opposite sexes.

Table (3) shows the water and fat content in the flesh of males and females of *L. niloticus* caught in the months from November to April, and grouped according to their maturity stages. It is evident that the group including larger individuals showed a more advanced stage of maturity in comparison with those consisting of smaller specimens. So, the influence exercised by the length groups on the fat content is manifested and so pronounced, that it overweighs the influence of the stage of maturity and the eventual sex difference.

Table 2. Variation of the fat content in the flesh of *L. niloticus* from the Nozha-hydrodrome according to different sexes.

Month	Fish length (cm.)	Fat (% of dry material)	
		Males	Females
November	52 — 53	13.70	14.70
December	39 — 40	13.40	41.10
	51 — 52	11.90	12.20
January	52 — 53	13.60	14.10
February	37 — 38	10.50	11.70
	39 — 40	14.09	15.70
March	38 — 39	11.40	12.10
April	38 — 39	11.20	11.80
August	43 — 44	16.6	19.0
	44 — 45	17.0	23.0

Table 3. Percentage of moisture and fat content in the flesh of *L. niloticus* of the Nozha-hydrodrome according to sex and stage of maturity.

Sex	Stage of maturity	No. of samples	Average length (cm.)	Moisture (%)	Fat content (%)
Males	I	13	30.1	79.71	11.00
	II	11	44.4	78.23	12.11
	III	3	45.0	78.13	12.69
	IV	—	—	—	—
Females	I	8	31.0	79.49	11.91
	II	12	41.9	79.06	12.31
	III	5	48.9	78.40	12.50
	IV	1	52.0	77.70	13.20

II — BARBUS BYNNI

Here also occurs a variation in the chemical composition of flesh between individuals of the same size or of different sizes, having the same sex or opposite sexes, and at one stage of maturity or another. The fat content and consequently the water percent in the flesh of *B. bynni* undergo a wide range of variation (even wider than that established for *L. niloticus*).

The data of fat content in the muscles of different length groups of *B. bynni* in the period from November, 1968 to July, 1969, showed that the highest value (31.80%) was obtained for a female of 73 cm.T.L. and 5200 gm. in weight taken in November. The lowest value (8.40%) was obtained for a male of 73 cm.T.L. and 5000 gm. in weight taken in January. At the same time, the water content varies between 87.60 and 69.60%, but inversely with the fat content of the flesh.

Monthly variation of the fat content:

When the mean values of the fat content for the various length groups are arranged according to different months (Table 4), some irregularities were observed. However, the high values of fat content were recorded for samples taken in November, whilst the low values were for samples taken in March and

April. The considerable decrease of fat content in March was mostly due to the relatively low mean value of the total length of fish sampled during that month.

The amount of fat was high during November due to the influence of the feeding conditions in the preceding months. In the period from December to March and April, the decrease of fat content is to be thought in the decreasing of feeding intensity, as a result of the decrease in temperature during the relatively cold season ((winter). Similar results has been found in other fishes. El-Saby (1934) has shown that the fat content in *Sardinella* spp. was only low

Table 4. Monthly variation of the fat content in the flesh of *B. bynni* from the Nozha-hydrodrome according to different length groups (Number of samples between brackets)

Month	Length group (cm.)					Grand Average
	<30	31—40	41—50	51—60	>60	
November	10.50 (1)	13.45 (2)	15.10 (1)	21.40 (3)	25.05 (2)	18.53 (9)
December	12.00 (2)	11.05 (2)	—	19.47 (3)	22.10 (1)	15.83 (8)
January	17.10 (1)	13.68 (4)	15.55 (2)	19.37 (3)	— —	16.10 (10)
February	—	14.40 (2)	16.40 (1)	18.33 (3)	17.10 (1)	16.76 (7)
March	—	13.58 (4)	—	15.40 (1)	—	13.94 (5)
April	12.25 (2)	14.80 (3)	17.60 (1)	17.95 (2)	18.50 (1)	15.66 (9)
July	9.8 (6)	13.1 (1)	17.3 (1)	27.3 (2)	—	14.34 (10)
Grand Average	11.24 (12)	13.57 (18)	16.25 (6)	20.06 (17)	21.56 (5)	

during the summer breeding period, and increases by about 30% of the total weight during autumn, when they feed excessively on the bloom of plankton organisms.

Fat content in relation to fish length :

The amount of fat in the flesh of *B. bynni* and within the range of each length group, differs according to different individuals. However, calculating the mean values of fat content obtained from the analysis of samples of the same length group during the same month, a greater regularity in the fat content becomes noticeable (Table 4). It is evident that the fat content is generally higher for larger fishes than for smaller ones. This is mostly due to the intensive growth of smaller fish.

Fat content in relation to sex and stage of maturity:

When comparing the fat content of males and females of nearly equal sizes, obtained in the same month, we found that the females contained some more fats in their flesh than the males (Table 5). Again, this may be due to differences required either by translocation or synthesis, to build up the organs of the opposite sexes. Also, it has to be mentioned that beside the differences in sex, there are always differences in Weight, which may cause that difference in the fat content of males and females.

Table 5. Variation of fat content in the flesh of *B. bynni* from the Nozha-hydrodrome according to different sexes.

Month	Length range (cm.)	Males		Females	
		Fish weight	Fat content	Fish weight	Fat content
November	55 — 56	1885	14.80	1920	23.20
December	54 — 55	1810	11.40	2050	18.70
January	40 — 41	645	13.90	690	17.20
February	56 — 58	2480	19.70	2500	23.80
March	33 — 34	370	9.50	380	13.90
April	28 — 30	250	12.20	295	13.00
July	56 — 58	2440	26.1	2510	28.1

According to El-Saby (1937) the amount of fat present in the tissues of *Sardinella aurita* and *S. eba* was not influenced by the difference of sex. But, the author maintained that the species with a high fat content show considerable individual differences in this respect. This is clearly shown when comparing the data of Table (5) (for *B. bynni*) with that of Table (2) (for *L. niloticus*).

The average results obtained for the water and fat contents in the flesh of males and females of nearly equal lengths and of the same stage of maturity, during the months from November to April are represented in Table (6). It is clear that fishes of larger length groups showed a more advanced stage of maturity in comparison with the smaller ones. Here it is also evident that the influence exercised by the length group on the fat content is manifested and so pronounced, that it overweighs the influence of the stage of maturity and the eventual sex difference.

Table 6. Percentage of moisture and fat content in the flesh of *B. bynni* from the Nozha-hydrodrome according to sex and stage of maturity.

Sex	Stage of maturity	Number of samples	Average length (cm.)	Moisture (%)	Fat (%)
Males	I	16	29.2	78.42	12.98
	II	1	33.0	77.10	11.90
	III	5	50.6	76.94	19.80
	IV	4	55.2	75.90	19.98
Females	I	9	37.7	78.38	14.07
	II	5	54.2	77.32	17.46
	III	5	58.6	75.94	21.48
	IV	4	63.2	75.10	22.23

Thus, it has to be concluded that sexual maturation has no causal connection with the decrease of the fat content in the flesh during winter. This is clearly shown from Table (6).

CONCLUSION

During the period of investigation (from November, 1968 to September, 1969), the fat content in the flesh of both Cyprinids (*L. niloticus* and *B. bynni*) showed a clear monthly variation. In spite of some irregularities, the highest values were mostly found in autumn and this coincide with the high feeding activity during the previous summer months. The lowest values, on the other hand, were found in spring and this coincide with the decrease of the feeding activity during the previous winter months.

The fat content in the flesh of both species was found to be higher in larger fish than in smaller ones. This was most probably caused by the intensive growth of the smaller fish. Also it has to be mentioned that the monthly variation in the fat content is more obvious for larger fish than for smaller ones. This is most probably due to the fact that during winter the feeding intensity of smaller fish is always superior over that of larger fish (Hashem, 1973).

In most cases, the females of both species (*L. niloticus* and *b. bynni*) show somewhat higher fat content in their flesh than the males. This may be due to differences required either by translocation or synthesis, to build up the organs of the opposite sexes.

The initial ripening of the gonads, before the beginning of the spawning season, did not notably affect the amount of fat in the flesh of both species. That is to say, there is no observed influence for the advanced stage of maturity on the fat content in the flesh of these fishes. Thus it can be concluded that gonad maturation is mostly carried out on the expense of internal-fat rather than that of the muscle-fat.

During the period of investigation, it was also proved that the amount of fat in the flesh of *B. bynni* is more than that of *L. niloticus*. That is to say, within the same month and for the same length group, the fat content in the flesh of *B. bynni* was nearly double that of *L. niloticus*. Thus, the *B. bynni* of the Nozha-hydrodrome is more fatty than *L. niloticus*.

Also, it has to be mentioned that the water content in the flesh of both species undergo a wide range of variation, but inversely with the fat contents, i.e. as the fat increases the water content decreases, and vice-versa.

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