

A STUDY ON THE LIPID DISTRIBUTION PATTERN IN MUSCLES OF TWO TELEOSTS, *ARIUS DUSSUMIERI* AND *OPHIOCEPHALUS STRIATUS*

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The distribution of total lipids in different parts of the body of *A. dussumieri* and *O. Striatus* has been studied and reported in this paper.

INTRODUCTION

Since data on the proximate composition of fish have considerable applied value in human nutrition as well as in the preparation of animal feeds, a better knowledge in this field is warranted. A review of the literature on this aspect of fish has been given by Stansby (1962) and he has stressed the need for further study. Despite the considerable amount of work done in this field of biochemical composition of fish, comparatively little attention has been paid to the variations met within the constituents. As a matter of fact, one of the major handicaps in the establishment of proximate composition of fishes is the relatively large variation in values, especially of lipids, from species to species and even in the individual fish at various times of the year. In addition to the individual variations, it has been reported that variations in composition occur in different portions of the body of the fish also. Certain amount of work has been

done on this aspect of variations of body constituents in different regions of fishes. Brandes and Dietrich (1953) have studied the variations in lipid in herring fillet. Alexander (1955) reported a higher lipid content in red muscles of certain fishes as compared to their white muscles and this has been corroborated by Bokdavala and George (1967). Investigations on various lipids of muscles of tuna have been conducted by Igarashi *et al*, (1960). However as there has been no systematic work done on differential distribution of lipids in muscles of fishes in our country, it was thought that such a study on the lipid content of muscles of different body regions of fishes would yield useful data.

MATERIALS AND METHODS

For a preliminary study, two freshwater teleosts, *Arius dussumieri* and *Ophiocephalus striatus*, which are very commonly used by local population, were selected. The body was divided into five

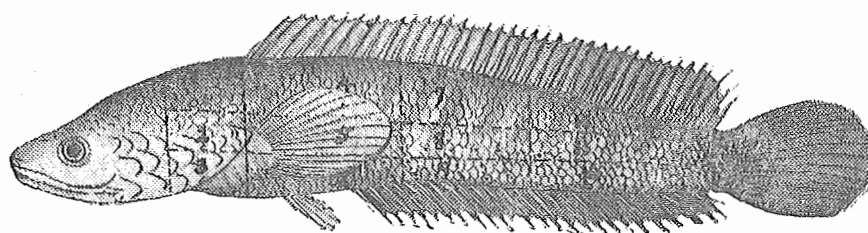
were taken separately from the white muscles and assayed as one lot for lipids. However, in *O. striatus* the red muscles were present only in insignificant amounts and as such they were assayed along with the white muscles. Total lipids were estimated by Soxhlet extraction by employing an adapted method of Seeler and Dietrich (1951).

Ten fishes were taken in each case and the data obtained for lipids in the muscles of various zones of the two fishes *A. dussumieri* and *O. striatus* were statistically analysed employing the analyses of variance. The means with standard deviations

A detailed black and white illustration of a fish, likely a catfish, shown in profile facing left. The fish's body is covered with a grid of dashed lines for measurement. Numbers 1 through 13 are placed at various points along the body: 1 at the snout tip, 2 at the eye, 3 at the mouth, 4 at the dorsal fin base, 5 at the pectoral fin base, 6 at the pelvic fin base, 7 at the anal fin base, 8 at the dorsal fin, 9 at the mid-body, 10 at the anal fin, 11 at the pelvic fin, 12 at the caudal peduncle, and 13 at the caudal fin. The letters A, B, and C are placed below the body: A is under the pelvic fin, B is under the anal fin, and C is under the caudal peduncle.

- a—Cephalic Region
A—Anterior Dorsal Fin Region
B—Region between Anterior and Posterior Dorsal Fin
C—Posterior Dorsal Fin Region
D—Caudal Region

A B C D



- a—Cephalic Region
A—Anterior aspect of Dorsal Fin — 1st 10 rays
B—Middle ,, ,, — 11th to 21st ray
C—Rear ,, ,, — 22nd ray onwards
D—Caudal Region

TABLE I LIPID CONTENTS IN MUSCLES OF DIFFERENT ZONES OF VARIOUS BODY REGIONS OF *ARIUS DUSSUMIERI* EXPRESSED AS G/100 G OF WET MUSCLE*

Horizontal	Vertical →	Cephalic Region a	Anterior Dorsal fin region A	Region between anterior and Posterior Dorsal fin B	Posterior Dorsal fin region C	Caudal fin region D	Horizontal Series	Red Muscles
1	(1) 1.59 ± 0.23 7.58	(4) 2.39 ± 0.39 11.11	(7) 1.82 ± 0.31 8.31	(10) 2.02 ± 0.21 9.66	(13) 2.71 ± 0.50 12.38	2.11 ± 0.17	10.56 ± 1.02 35.87	
2	(2) 2.59 ± 0.39 12.17	(5) 6.21 ± 3.38 27.29	(8) 2.69 ± 0.64 11.92	(11) 2.39 ± 0.41 11.40	(14) 3.40 ± 0.66 15.47	3.46 ± 0.63		
3	(3) 6.91 ± 2.27 29.09	(6) 8.23 ± 3.33 32.21	(9) 8.22 ± 2.10 38.38	(12) 3.87 ± 0.91 16.29	(15) 4.26 ± 1.15 17.57	6.30 ± 0.84		
Vertical Series		3.70 ± 1.33	5.61 ± 1.39	4.24 ± 1.63	2.76 ± 0.46	3.46 ± 0.37		

* Ten fishes were analysed and the data analysed statistically employing analysis of variance. Mean values with standard deviations are given. Zone numbers are given in brackets. Lipid content corrected to g/100 g of dry muscle given at bottom right side of the column.

TABLE II LIPID CONTENT IN MUSCLES OF DIFFERENT ZONES OF VARIOUS BODY REGION OF *OPHIOCEPHALUS STRIATUS* EXPRESSED AS G/100 G OF WET MUSCLE*

Horizontal	Vertical	Cephalic Region	Anterior region of Dorsal fin 1st 10 Rays	Middle portion of Dorsal fin 11th - 21st Rays	Rear region of Dorsal fin	Caudal fin region	Horizontal series
	→	a	A	B	C	D	
1	(1) 1.10 ± 0.28 4.91	(4) 1.76 ± 0.26 8.23	(7) 1.46 ± 0.34 6.85	(10) 1.34 ± 0.17 6.13	(13) 2.64 ± 0.48 12.02	1.66 ± 0.23	
2	(2) 2.10 ± 0.25 9.76	(5) 2.30 ± 0.30 10.45	(8) 2.30 ± 0.57 10.22	(11) 1.85 ± 0.31 8.15	(14) 2.55 ± 0.45 11.64	2.22 ± 0.10	
3	(3) 2.60 ± 0.32 11.39	(6) 2.88 ± 0.43 12.08	(9) 4.21 ± 0.91 16.37	(12) 2.28 ± 0.45 9.56	(15) 3.78 ± 0.77 14.98	3.14 ± 0.32	
Vertical Series		1.39 ± 0.36	2.31 ± 0.26	2.66 ± 0.66	1.82 ± 0.22	2.97 ± 0.31	

* Ten fishes were analysed and the data analysed statistically employing analysis of variance. Mean values and standard deviations are given. Zone numbers are given in brackets. Lipid content corrected to g/100 g of dry muscle given at bottom right side of the column.

along with the corrected means of the lipid content expressed as percent dry muscle are given in the tables I & II respectively.

RESULTS AND DISCUSSION

The data obtained for distribution of

lipids in muscles of different regions in *A. dussumieri* present an interesting pattern with reference to the various zones of the body. As for the dorsal region of the body, zone 1, which is nearest to head and located at the anterior aspect of the

anterior dorsal fin has the least value of 1.59% with zone 4 in region of the anterior dorsal fin and zone 13 at caudal region giving comparatively higher values of 2.39% and 2.71% respectively. The other two zones viz; 7 of dorsal region B (between anterior and posterior dorsal fins) and 10 of region C at the posterior dorsal fin region, exhibit values of 1.82% and 2.02% respectively. In the middle portion of the body muscles in the region B, zone 5 has 6.21 % with zone 14 of D region having 3.40%. However zone 8 of B region and zone 11 of C region have smaller values of 2.69% and 2.39%. Regarding the ventral portion of the body all the regions and zones possess higher values, zone 3 (6.91%) zone 6 (8.23%) zone 9 (8.22%) zone 12 (3.87%) and zone 15 (4.26%) with zones 6 and 9 having definitely higher values than the rest. The red muscles exhibit a value of 10.56% which is comparatively higher than that of any other region and this is in conformity with earlier reports (Alexander, 1955; George *et al* 1967).

In *O. striatus* also the muscles of the dorsal region have higher lipid values at region D (caudal) and A (anterior dorsal fin region), zones 13 and 4 having 2.64% and 1.76% respectively. The anteriormost zone 1 has a value of 1.10% whereas middle zones 7 and 10 have intermediate values of 1.46% and 1.34%. Regarding the middle lateral regions of the body, the zones 2, 5 and 14 exhibit values of 2.10%, 2.30% and 2.55% respectively with zones 8 and 11 having 2.30% and 1.85% respectively. At the ventral aspect of the body the lipid values in all the zones are relatively higher than those of the upper zones, zones 6, 9 and 15 having 2.86%, 4.21% and 3.73% respectively. As for zone no 3 it has 2.60%, 12.0%, 2.28% and zone 15, 3.73%. In both the fishes an inverse relationship between the lipid and the moisture contents of the muscle was observed.

A careful study of the data on the lipid contents of the muscles of the various zones of different regions of the body of the cat fish, *A. dussumieri*, suggests that in general there is a definite dorsoventral gradation in lipid concentration in all the regions of the body. The muscles of the ventral portions of the body exhibit much higher values with five distinct peaks representing the ventral zones 3, 6, 9 12 and 15. Among these zones of the ventral aspect of the body, the belly flap portion comprised of zones 9 (8.22%) and 6 (8.23%) show the highest lipid contents. Brandes and Dietrich (1953) working on the lipids of the herring fillet obtained the highest value for the belly flap region. Later Igarashi *et al*, (1960) working on the lipids of tuna, *Thynnus orientalis* reported higher values for various zones of ventral aspect of the body. The red muscles possess a fairly high lipid content in comparison to the white muscles of the various zones and this is mainly due to the fact that the red muscle fibres metabolise fat as their main fuel.

As for *O. striatus*, the highest concentration of lipids is also met with at the belly flap portion; zones 6 and 9 exhibit values 2.88% and 4.21% respectively. Hence similar to the cat fish *Arius*, *Ophiocephalus* also shows a dorsoventral gradation in lipid distribution. In fact, the statistical analysis of the data on lipid content in muscles of different regions of the fishes, as given in tables I and II indicate that the dorsoventral gradient in lipid distribution is quite valid and meaningful. However the data regarding the lipid concentration along the vertical zones anteroposteriorly suggest that in *Ophiocephalus* there is a statistically significant trend of lipid content increasing at dorsal fin area, showing a decline at mid region and again increasing at the caudal portion. This trend although shown by *Arius* is not so

marked. The lowest lipid content in both the fishes in the vertical series is shown by the cephalic and the next by the middle zone wherein the muscles are comparatively less active. Nevertheless the caudal zone has higher lipid concentration. Actually this trend in lipid gradation to the caudal region is in contrast to the data presented by Brandes and Dietrich (1953) who observed a progressive increase in lipids from the tail region to the anterior dorsal fin and then the value diminishing at the cephalic region. The higher lipid values exhibited by the muscles of the caudal region may possibly be due to the greater demands of energy for the muscular effort for locomotion of the fishes done by the lashing of the tail. In fact George *et al* (1967) after a study on the lipids of fish muscle have provided data which support this inference.

SUMMARY

The muscles of the various regions and zones of the body of the two teleosts, *A. dussumieri* and *O. striatus* have been analysed for lipid contents. There is a significant dorsoventral gradient in lipid concentration exhibited by both the fishes with higher lipid values in the ventral aspect of the body, especially the belly flaps. As regards the vertical series, both the fishes exhibit comparatively higher lipid contents at the dorsal aspects of the caudal region and at

anterior portion of the dorsal fin area with lower lipid values at cephalic and middle portions of the body. The red muscle of *Arius* exhibits higher lipid content than the white muscle.

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