

FAT AND WATER CONTENTS OF THE MUSCLE AND OVARY
DURING THE MATURATION CYCLE OF *PSEUDOSCIAENA ANEUS*
(BLOCH) AND *JOHNIUS CARUTTA* (BLOCH)

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In fishes fat accumulates mostly in muscles, liver, intestine and gonads for utilization during the reproductive activity (Milroy, 1898; Bruce, 1924; Channon and Saby, 1932; Lovern and Wood, 1937; Hickling, 1947; Bailey, 1952; Hoar, 1957; Love, 1957). Previous investigations (Milroy, 1898; Lovern and Wood, 1937; Hickling, 1947) revealed that during maturation the fats which are stored in various organs are transferred to maturing gonads.

Durairaj (1962) reviewed some previous investigations made with reference to nutritive value and seasonal variations in fat contents of the fishes in India.¹

The present problem was taken up during the period of 1961-62 with a view to studying the quantitative distribution of fat and water in flesh and ovaries in different stages of maturity of *Pseudosciaena aneus* and *Johnius carutta*.

MATERIAL AND METHODS

Specimens of *P. aneus* and *J. carutta* were obtained from trawl catches of M. T. Ashok and M. V. Champa at Visakhapatnam. The stage of maturity of fishes was decided by using the classification of International Council for the Exploration of the Sea. The required quantities of ovary and muscle were taken and weighed. Later they were dried in an electric oven to constant weight. The difference in weight gave the water content and its percentage was calculated. Fat from the dried tissues was extracted in Soxhlet apparatus using ether as a solvent.

OBSERVATIONS

Seven stages of sexual maturity are distinguished.

Stage I Immature gonads which are small and colourless.

Stage II Immature gonads which are slightly larger than in the previous stage, with a few oocytes.

¹ Recently Satyanarayana Rao (1967) studied reproductive cycles and lipid levels in *Leiognathus splendens*. *J. mar. biol. Ass. India*, 9 (2): 303-322.

- Stage III Maturing ovaries with ova visible to the naked eye and containing fair amounts of yolk.
- Stage IV Mature ovaries which occupy the entire body cavity and containing large opaque ova.
- Stage V Ovaries yellowish in colour, large and thick, ova large and translucent.
- Stage VI Ovaries with oozing ova which are transparent. Eggs easily extruded by slight pressure on the flanks.
- Stage VII Ovaries flaccid occupying approximately half the length of the body cavity, reddish and blood-shot.

The percentages of fat and water in the body muscles and ovaries of *P. aneus* and *J. carutta* are shown in Tables 1 and 2. It is seen that in *P. aneus*, the fat content of the body muscles increases from 5.263% in stage I to 12.235% in

TABLE 1. *Quantitative distribution of fat and water in the flesh and ovary of Pseudosciaena aneus (Bloch).*

Stage of maturity	Weight in grams per 100 grams of dried body muscles and ovary			
	Body muscles		Ovary	
	Fat	Water	Fat	Water
I Developing	5.263	76.415	8.267	74.346
II Immature	6.697	75.746	14.074	68.518
III Maturing	10.000	75.505	14.610	68.097
IV Mature	12.235	70.814	28.661	56.686
V Fully mature	7.122	75.128	29.732	54.278
VI Spawning	4.243	77.200	8.161	77.461
VII Spent	2.421	77.744	7.769	78.168

TABLE 2. *Quantitative distribution of fat and water in the flesh and ovary of Johnius carutta (Bloch).*

Stage of maturity	Weight in grams per 100 grams of dried body muscles and ovary			
	Body muscles		Ovary	
	Fat	Water	Fat	Water
I Developing	5.431	75.982	11.111	70.502
II Immature	7.790	74.246	15.550	60.200
III Maturing	12.388	69.800	24.372	57.810
IV Mature	15.388	67.621	29.487	54.501
V Fully mature	12.444	69.202	30.582	53.003
VI Spawning	6.703	75.401	10.253	72.339
VII Spent	4.278	77.460	5.721	74.330

stage IV. The fat content from stage V to VII decreases from 7.122% to 2.421%. The water content decreases from 76.415% in stage I to 70.814% in stage IV. The water content from stage V to VII increases from 75.128% to 77.744%. The fat content of the ovary increases from 8.267% in stage I to 29.732% in stage V. From stage VI to VII the fat decreases from 8.161% to 7.769%. From stage I to V, the water content in the ovary decreases remarkably from 74.346% to 54.278% and from stage VI to VII it increases from 77.461% to 78.168%.

In *J. carutta* the fat content of the body muscles increases from 5.431% in stage I to 15.388% in stage IV. The fat value decreases from 6.703% in stage VI to 4.278% in stage VII. There is a decrease in water content from 75.982% in stage I to 67.621% in stage IV. Further there is a rise in fat content from 69.202% in stage V to 77.460% in stage VI.

The fat values of the ovary also show identical trend as in *P. aneus*. The values increase from 11.111% in stage I to 30.582% in stage V. There is a decrease in fat values from 10.253% in stage VI to 5.721% in stage VII. The water content of the ovary from stage I to V decreases remarkably from 70.502% to 53.003%. From stage VI to VII, the water content increases from 72.339% to 74.330%.

DISCUSSION

Hoar (1957) has stated that fat accumulates in various organs prior to maturation of gonads in many fishes. Bailey (1952) pointed out that in fishes like salmon and herring this storage and concentration take place in the muscle within and between the muscle fibres, while in sardine, cod, shark etc. it is in the liver. The amount and the period of concentration of fat in the storage organs are not precise since they depend on the kind of food and intensity of feeding as also on the stage of maturity of gonads. A correlation between the fat content of plankton and that of herring has been established by Wimpenny (1938). Dealing with the red mullet, *Upeneus indicus* Ramaswamy (1955) has also dealt on the influence on the fat value of food on that of fish. Chidambaram *et al.* (1952) attributed the two peaks of fat accumulation in the Indian mackerel to the feeding activity. Feeding intensity and accumulation of fat in the flesh was also recorded by Sekharan (1949, 1950, 1955) in *Dussumieria acuta*, *Pellona hoeverii* and *Trichiurus haumela*. Black and Schwartz (1950) in their study on the fat distribution in the South African pilchard have stressed the existence of correlation between the changes in fat content of muscles and the reproductive cycle.

Studies made by the present author on the food (unpublished) of *P. aneus* and *J. carutta* show they feed actively during maturity stages I-IV. The abundance of fat in the flesh of these fishes between the ovarian stages of I and IV therefore only suggests that fat is accumulated due to heavy feeding. The gradual reduction of muscle fat during the stages V - VII indicates the utilization of fat first by the

ovaries and later by the body during the spawning and post-spawning period. This view receives further support from the author's observations that feeding is very poor or absent in the spawning and spent fish. The gradual depletion of ovarian fat during the spawning and spent stages indicates the utilization of the ovarian fat by the ova that are liberated. It is probable that liver, visceral and mesenteric fat contribute more towards the demands of ovarian maturity than the flesh in *P. aneus* and *J. carutta*.

Milroy (1898) and Lovern and Wood (1937) stated that in *Clupea harengus* there is a depletion of fat in the lateral muscles during the maturation of gonads. But Bruce (1924) and Channon and Saby (1932) stated that there is no change in the fat content until the time of spawning. The present observations confirm the views of Channon and Saby (1932). Durairaj (1962) made similar observations in *Cirrhitidae*, a freshwater fish. He also stated that in this fish more fat is accumulated in the muscles than in the ovary.

Luhmann (1953) is of opinion that there is no correlation existing between ovarian growth and fat content in the gonad of the Baltic sea herring. He stated that factors like temperature, salinity and food should also be taken into consideration while studying the correlation between ovarian growth and fat content. But Meyer (1958) after reviewing the work of Luhmann and other workers tried to prove the existence of greater correlation between fat content and ovarian growth in herring. The present studies also show the existence of such a correlation in *P. aneus* and *J. carutta*. The fluctuation in the percentage of water content only shows its inverse relationship with fat.

SUMMARY

In *Pseudosciaena aneus* and *Johnius carutta* maximum fat is recorded in flesh in stage IV and in the ovary in stage V. Further, there is a relationship in the quantitative distribution of fat in flesh and ovaries. The water content in ovary and flesh shows an inverse relationship.

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