LEVELS OF CHOLESTEROL IN BLOOD SERUM AND GONADS IN RELATION TO MATURATION IN *ETROPLUS SURATENSIS* (BLOCH)

A. D. DIWAN AND L. KRISHNAN
Central Marine Fisheries Research Institute, Cochin 682031.

ABSTRACT

The value of serum cholesterol in male and female *Etroplus suratensis*, showing fluctuations in relation to maturity, was highest when GSI value was minimal and lowest when GSI was maximum. The gonad-cholesterol content in male showed high profile when GSI was low and lowest value was seen when GSI was maximum. In the female the recorded value of gonad cholesterol though high was not highest when GSI was lowest.

The cholesterol being the precursor for the synthesis of steroids, which in turn influencing the maturation phenomena, our study was aimed at finding out the cholesterol level in blood and gonads of males and females of the pearl spot, *Etroplus suratensis*, during different maturity stages. Mc Cartney (1966) had studied the influence of age and sex on total serum cholesterol levels in the brown trout. In maturing female *Salmo trutta* an increase in the free cholesterol in the blood had been observed by Felinska (1972). Jayashree and Srinivasachar (1979) had found the testicular cholesterol being in relation to maturation in the freshwater fish *Clarius batrachus*.

Specimens of *E. suratensis* of different lengths, ranging between 120-295 mm, were collected from the Cochin backwaters at monthly intervals for a period of one year (April 1983 to March 1984). In each month 8-10 specimens were utilized for the experimental work. The specimens were brought to

the laboratory in live condition and were kept in tubs containing aerated brackish water until use. For cholesterol estimation the blood was drawn from the dorsal aorta of each unanaesthetized fish through the gill aperature by a heparinized syringe. The blood samples were immediately centrifuged (at 3000 rpm) to get the serum. The blood serum thus obtained was subjected to cholesterol analysis.

After removal of blood, the fishes were sacrificed to take out the gonads. The gonads were weighed and, by the method of Yuen (1955), the relative weight, or gonadosomatic index (GSI), was calculated.

Cholesterol was estimated by Hestrin's method (1949), using extra pure cholesterol as the standard.

Based on the gonadosomatic index, and aided by colour, shape and size of the gonad, four maturity stages, including the fully ripe, were determined. As spawned animals were not observed in the collected samples, this stage has not been included in the classification.

Stage I (Immature): Ovary very thin and translucent, slightly pinkish, occupying less than half of the body cavity. GSI value varied between 0.020 to 0.066. Testis very thin, extending half of the body cavity. GSI varied between 0.0033 to 0.0089.

Stage II (Maturing Virgin): Ovary occupying half of the body cavity, light yellowish. GSI varied between 0.20 to 0.72. Testis extending more than half of body cavity, dull-white in colour. GSI varied between 0.010 to 0.019.

Stage III (Ripening): Ovary occupying three-fourth or more of the body cavity, yellowish, egg mass appeared opaque. GSI varied between 1.16 to 1.98. Testis extended three-fourth of the body cavity, whitish in colour. GSI varied between 0.020 to 0.027.

Stage IV (Ripe): Ovary occupying the entire body cavity, deep yellowish brown. Most of the egg mass appeared to be transparent and loose. GSI varied between 2.16 to 2.96. Testis extending the full length of the body cavity, very soft and creamy white, outer margin irregular, GSI varied between 0.034 to 0.072.

The results obtained are illustrated in figure 1. From this it may be seen that the cholesterol contents in general fluctuated in relation to different stages of maturity in both males and females. The value of serum cholesterol in males was highest when the GSI value was minimal and lowest when the GSI value was maximum. The cholesterol content in the gonads also showed a similar trend, the value highest when the GSI was minimal and the value lowest when the GSI was maximum. The cholesterol content in the blood serum in the females showed a trend similar to that in the males, except that slight

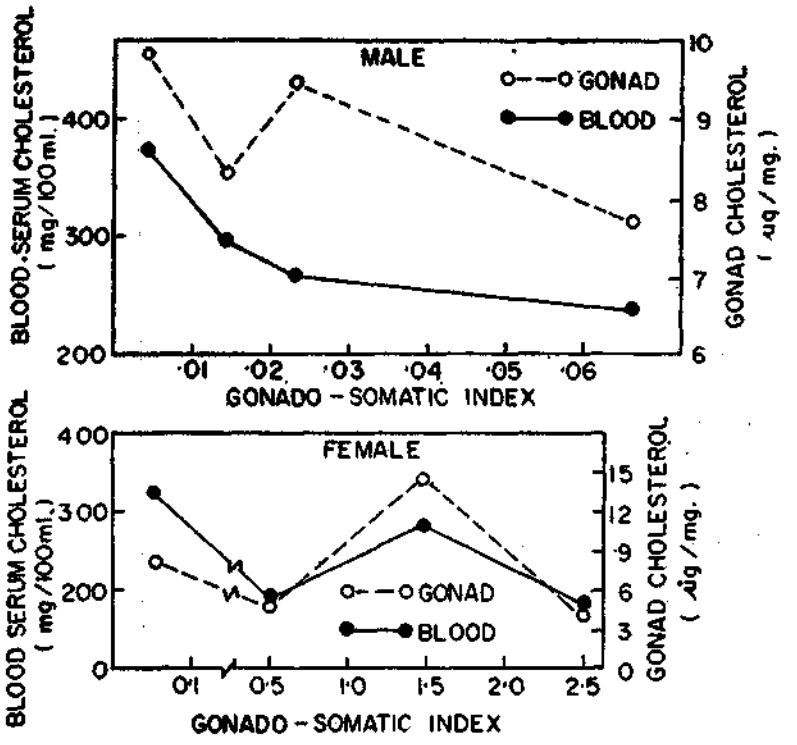

FIG. 1. Blood-serum cholesterol in relation to GSI in *suratensis*.

increase in the value was noticed during the third stage of maturity. The level of cholestrol in gonad of female fish was not the highest, even though it showed higher values when the GSI was lowest. The lowest cholesterol content was observed when the GSI value was maximum.

Hence, in general, both blood-serum and gonad cholesterol contents showed higher values when the GSI was lowest, i.e. during the early phase of maturation; and the values were lowest in the late phases of maturation when GSI was highest. The cyclical changes in the levels of gonad cholesterol may be due to gonadal activity prior to and during the breeding season. The activity and maintenance of the gonoducts during the elaborate process of maturation has been shown to depend upon the accumulation of steroids like estrogen and androgen respectively in male and female fish, *Heteropneustes fossilis* (Nayyar and Sundararaj, 1970). It is assumed that the increase in the weight of gonad (GSI) is related to the accumulation of steroid levels. This level decreases soon after the act of spawning (Jayashree and Srinivasachar 1979). If this concept is acceptable, then the corresponding increase or decrease in the precursors of steroids during different stages of maturation could be expected. The results obtained in the present study are highly indicative of such a change. A number

of workers have described the role of cholesterol being a precursor for steroidogenesis (Krum et al 1964; Major et al 1967; Sandor 1979). Cholesterol is present in the steroidogenic glands and the tropins are known to affect the tissue concentration of this sterol in the target organs (Sayers et al 1944; Levin and Jailer 1948). In the present investigation, the lowest levels of cholesterol in the gonads of both males and females was observed when GSI was maximum. This perhaps may allow us to presume that the available precursor stores have been utilized for synthesis of steroids as per the concept mentioned above. Jayashree and Srinivasachar (1979), while working on the catfish *Clarius batrachus*, observed the lowest cholesterol levels in testicular tissue during the phase of functional maturity and highest level during the phase of slow spermiogenesis (early preparatory period). The results obtained in the present work are identical to the observation of Jayashree and Srinivasachar (1979).

Our results are in conformity also with the findings of Idler and Tsuyuki (1958) and Mc Cartney (1967) that during the spawning time (when the GSI is expected to be maximum) the serum cholesterol level was reduced significantly in both male and female fish. In the present investigation the presence of the highest profile of serum cholesterol level during I stage of maturation period and high profile in III stage might be due to the redistribution of cholesterol from other tissues to the early maturing gonads. The reason for the unusual fall in the cholesterol level in blood serum and gonad during II stage of maturity remains obscure and needs further to be studied. Dannevig and Norums (1982) had observed high levels of cholesterol in immature *Salmo alpinus* with decreasing levels during the maturation period.

Contrary to the observation in the males, in females, in spite of a higher value of gonad cholesterol in I stage, the highest value of cholesterol was observed during III stage and the value dropped to the lowest level in the IV stage. From the figure it is observed that in male also the value for testis cholesterol level increased slightly in III stage compared to II. This increase is significant in the case of the female. The probable explanation is that the higher cholesterol reserves in the maturing gonad (i.e. Stage III) may be the precursor store reserves which would be utilized during the stage of functional maturity, i.e., the last phase of maturation (Stage IV). The lowest value of gonad cholesterol in stage IV corroborates our explanation. This increase in value of the gonad cholesterol in stage III both in males and in females of *E. suratensis* finds a considerable similarity to the observation of Lewander et al (1974), who had described the presence of high levels of cholesterol both in the maturing gonads and in the blood plasma of silver eels ready for migration. During spawning the serum cholesterol levels were observed to be reduced significantly in both male and female fish.

We express our sincere thanks to Dr. E. G. Silas, former Director for providing necessary facilities in the present work. We are grateful to Dr. P. V. Rao, Head, PNP Division, for critically going through the manuscript.

REFERENCES

DANNEVIG, B. H. AND K. R. NORUM. 1982. *Comp. Biochem. Physiol.* 73: 771-777.

FELINSKA, S. 1972. *Acta Icthyologica et piscatoria* 2(2): 15-19.

HESTRIN, S. 1949. *J. Biol. Chem.* 180: 249.

IDLER, D. R. AND H. TSUYUKI. 1958. *Can. J. Biochem. Physiol.* 36: 783-791.

JAYASHREE, R. AND H. R. SRINIVASACHAR. 1979. *Proc. Indian. Natn. Sci. Acad.* 45|5.: 526-533.

KURUM, A. A., M. D. MORRIS AND L. L. BENNETT. 1964. *Endocrinology* 74: 543.

LEVIN, L. AND J. W. JAILER. 1948. *Endocrinology* 43: 154-166.

LEWANDER, K., G. DAVE, M. L. JOHNSSON-SJOBECK, A. LARRSSON AND U. LIDMAN. 1974. *Comp. Biochem. Physiol.* 47: 571-581.

MAJOR, P. W., D. T. ARMSTRONG AND R. O. GREEP. 1967. *Endocrinology* 81: 19.

MC CARTNE, T. H. 1966. *Fish. Res. Bull.* 29: 72-75.

MC CARTNEY, T. H. 1967. *Fish. Res. Bull.* 30: 42-45.

NAYYAR, S. K. AND B. I. SUNDARARAJ. 1970. *Morph.* 130: 207-226.

SANDOR, G., M. A. SAYERS, E. G. FRY, A. WHITE AND C. N. H. LONG. 1944. *Yale J. Biol. Med.* 16: 361-392.

YUEN, H. S. H. 1955. *Spec. Sci. Rep. US Fish Wild Serv.* 150: 30.