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Experimental studies on the changes in the female gonad of immature and mature freshwater fish, *Heteropneustes fossilis* (Bloch)

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Abstract

The present paper deals with the study of amino acids and lipid concentration in the immature and mature oocyte in the fish *Heteropneustes fossilis*. It was observed that the essential amino acids under the influence of gonadotrophins play a vital role in the gonadal maturation as well as in the synthesis of various enzymes needed for steroidogenesis. In the present study, the rate of incorporation of amino acids and their transformation in gonads indicate their vital role in the maturation of gonads. In addition to amino acids, the lipid fraction especially the ester cholesterol and the phospholipid were also found to play a significant role during the sequential changes which occur during maturation process of the gonads of *Heteropneustes fossilis*.

Key words : amino acids, *Heteropneustes fossilis*, steroidogenesis, fish.

Introduction

The reproductive cycle of many fishes is reflected by significant changes in the size of the gonads throughout the year. The development of ovaries, maturation and ovulation in fish correlate with the rate of biosynthesis and plasma concentration of certain steroids and trophic hormones⁴.

In most species, administration of an effective hormone may result in enhancement of maturation of oocyte without inducement of ovulation^{1,3,5,8}. Saxena Sahai and Jain reported in *Blennius philis*, *Notopterus notopterus* and *Nandus nandus* that the exogenous synthesis of protein yolk precursors occurs in the liver from where transported into the ovary through blood stream which accumulates in the cortical ooplasm and triggers the vitellogenesis. There is much evidence about the ovarian growth and maturation which are influenced

by environmental factor in a number of teleost species, but relatively little is known about role of external factors in controlling the final maturation and ovulation of the oocytes is known and hence, the present study was undertaken to assess the rate of incorporation of amino acids into the ovary and their role in the maturation of gonads, follicular epithelium, and ovulation in the fresh water fish, *Heteropneustes fossilis* (Bloch).

The experimental fishes were collected from local areas and acclimatized to the laboratory conditions in the aquarium tanks. Gonads were collected from immature and mature experimental female fish and subjected to biochemical methods to assess the free amino acids and lipid changes. Paper chromatographic methods were used for amino acids. Sachs and Wolfman⁶ method was used for extraction of lipid from gonads.

Table-1 Amino acid contents of mature and immature oocytes in *Heteropneustes fossilis*.

S.No.	Amino acids G.S.I.	Immature 0.2632±0.10593 M±σ	Mature 0.4005±0.0273 M ± σ
1.	Hydroxyproline	0.32 ± 0.02	0.28 ± 0.0
2.	Glutamic acid + Threonine	0.24 ± 0.03	0.21 ± 0.01
3.	Glycine + Serine	0.18 ± 0.02	0.23 ± 0.01
4.	Lysine	0.18 ± 0.19	0.15 ± 0.02
5.	Arginine	0.14 ± 0.02	-
6.	Histidine	0.12 ± 0.02	0.15 ± 0.02
7.	Valine+Methionine	0.05 ± 0.02	0.12 ± 0.02
8.	Leucine	0.02 ± 0.03	0.05 ± 0.01
9.	Ornithine	0.03 ± 0.01	0.09 ± 0.02

M = Mean

σ = Standard Deviation

In the present study it was observed that the free amino acid composition of maturing and matured ovary is almost similar (table 1). The quantitative measurements also show that there is little variation between maturing and matured ovaries. It is interesting to know that at these stages the ovary contains all the essential amino acids. Among the amino acids recorded were hydroxy proline, glutamic acid + Threonine Glycine + Serine, Lysine Arginine and Histidine are in higher concentrations as valine + Methionine, Leucine and Ornithine are in lower concentrations (table 1).

It was further observed that in immature females the phospholipid, free cholesterol and triglyceride concentration is less when compared to the matured females. The Triglyceride content is very less in immature ovary but there is high accumulation of Triglycerides in mature ovary. The cholesterol ester was found to be in higher concentration in immature ovary compared to the matured ovary. The occurrence of the highest diameter range of mature ova in ovaries in each spawning season indicates that there is group-synchronous development of oocytes in *H. bimaculatus* and this fish spawns only once (abbreviated spawning) during a breeding season.¹⁰

Our findings coincide with the results of the previous workers that maturation of the ovary depends mainly on the dietary protein content^{2,7}. Moreover, the present work on concentration of amino acids and lipids in the mature and immature gonads correlate the higher concentration of amino acids and cholesterol during vitellogenesis.

It may, therefore be concluded on the basis of the above findings that in a mature oocyte, the higher concentrations of amino acids as well as the lipid especially the cholesterol, fatty esters and triglycerides are

very well related with the maturation of oocyte and protein synthesis. It is quite probable as the exogenous synthesis of protein yolk precursor occurs in the liver is released into the blood and transported to the ovary.⁷ The knowledge about different stages of fish gonadal maturation provides important information necessary to prohibit fishing during the reproduction period.⁹

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