International Journal of Fisheries and Aquaculture Sciences.
ISSN 2248-9975 Volume 3, Number 2 (2013), pp. 143-149

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Seasonal Changes in the Histological Profile of the Testicular and Ovarian Cycle in Labeo Dyocheilus

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Abstract

This study represents detail description of histological developmental stages of gonads. Histological study is useful to define the stages of development in fish gonad and to determine the peak period of spawning as well as helpful in estimation of maturity of gonads and reproductive seasonality in gonads, so it provide precise information on gonadal developmental classification. Classification based on Cytology system of gonadal development provides the most accurate description of transformations taking place in the gonads. Study carried out at 29° 53' 55" N & 79° 21' 22" E for the period of three years. In this study, the gonadal development of *Labeo dyocheilus* was divided into seven stages. In the present study there is clear cut seven maturity stage in both male and female gonads of *Labeo dyocheilus*. They are Stage I - Immature or Virgin, Stage II - Maturing Virgin, Stage III - Developing, Stage - IV Maturing, Stage V - Ripening, Stage VI - Spawning or Running, Stage VII - Spent. Here we also observed that the male and female fish show similar kind of seven maturity stage in similar month. So testis and ovary attain maturity phase and spent phase in the same month and season. Present study is the detail description of oogenesis and spermatogenesis process in *Labeo dyocheilus.*

Keywords: Histology, microtomy, gonads, seasonal changes, *Labeo dyocheilus.*

INTRODUCTION

Reproduction of fishes especially teleost has received a growing amount of attention of fisheries scientists since last few years. This is due to economic interest as the teleost are being extensively used for aquaculture development to increase fish production for the nutritional requirement of increasing population. According to

Hosseinzadeh (1980) and Eigdery (1981), histological studies determine the peak period of spawning assessment & exploitation of fish, and biological characteristics & life cycle of a species. West (1992) investigated that histological studies provide precise information on gonadal development but are unfortunately slow to undertake and are expensive because they involve complex laboratory techniques. The importance of histological description of gametogenesis was emphasised by Booth and Weyl (2000) who noted that macroscopic staging must be validated if errors in the estimation of maturity and reproductive seasonality are to be minimised. In male fish, knowledge of spermatozoon ultra-structure has been used in systematic (Mattei, 1991) and was found to be important in the assessment of milt quality (Billard, 1978). Present study represents the first attempt in a detailed histological description of oocyte developmental stages, characterization of the ovarian and testicular cycle of *Labeo dyocheilus*.

STUDY AREA, MATERIAL AND METHODS

The sampling was carried out in Uttarakhand state of India at Chaukhutia (Latitude: 29° 53' 55" N and Longitude: 79° 21' 22" E), annually between September 2009 to August 2012 for three years. About 12 adult individual (25-30 cm in length) in each months were collected. Histological studies of gonads were done by a method described by Humason (1972).

RESULTS

In this study, the ovarian and testicular development of *Labeo dyocheilus* is divided into seven stages. The oogonia and spermatogonia pass through a number of maturation stages to form ripe ova and sperm. Which involve complicated changes in cytology, cytoplasm and nucleus ratio.

- Stage I (Immature or Virgin): All the oocytes were in the previtellogenic stage. Oogonium was found in bunch, tunica albugenia was thick and the stroma was well developed. In the testis tunica was thicker; all of the stages of the spermatogenesis could be seen in the form of spermatogonia, spermatocytes, spermatids and sperms. (Photo. A & B).
- Stage II (Maturing Virgin): Majority of the oocytes was small, comprised of oogonia and primary oocytes. Some oocytes were in the chromatin nucleolar stage. The biggest present oocytes were in the early peri-nucleolus stage. The stroma of the ovary was well developed, while the tunica albugenia was thick. There was no active spermatogenesis in the testis. Some lobules were devoid of sperms but had a big and empty lobule lumen with no spermatogonial clusters. (Photo. C & D).
- Stage III (Developing): Primary oocyte was dominated, but some early stage of secondary oocyte in the yolk vesicle stage were also seen. The size of the oocytes was increased because of yolk vesicle deposition. The nucleus-to-cytoplasm ratio was also increased. Spermatogenesis, with all its stages, was actively going on. Lobules contained cysts at various stages of development.

(Photo. E & F).

- Stage IV (Maturing): In this stage, three types of oocytes could be seen. A very small group of primary oocytes was present, some were in the secondary stage and largest group was of tertiary-stage oocytes. These oocytes were characterized by a well developed zona radiate, true yolk granules and some fat droplets. The peripheral parts of the testis were less developed than the central part. Lobular boundaries were clearly demarcated and contain myoid cells. The interstitial tissue was also well developed. (Photo. G & H).
- Stage V (Ripening): As maturity advances, movement of the nucleus is seen. Along with this, there is sequestration of the oil droplets and the yolk granules. In testis the function of the lobules is mainly the storage of sperms. The interstitial tissue was well developed and the lobule boundaries were quite demarcated, contained myoid cells and the tunica was very thin (Photo. I & J).
- Stage VI (Spawning or Running): Histologically, gonads have only two types of oocytes, which are primary and tertiary oocytes. Occasionally, a secondary oocyte can also be seen. In testis the lobules were full and extended with sperms. Testes showed all stages of spermatogenesis while some lobules had only sperm in them. (Photo. K & L).
- Stage VII (Spent): The ovaries become flaccid due to the ovulation of mature eggs. Primary cells predominated in the ovarian cavity. Very few secondary and tertiary oocytes were seen, as they undergoing atresia. Very few sperm were seen in the lumen of the lobules. The germinal epithelium was of the discontinuous type, and the interstitium was well developed. (Photo. M & N).

DISCUSSION

It is well known that environmental factors can have pronounced effects on the timing of gametogenesis, vitellogenesis and maturation in fishes, found by Takashima et. al. (2008) and Miranda et. al. (2009). In this study, the oocyte development of *Labeo dyocheilus* was divided into seven stages. In the majority of teleost fishes, the process of oogenesis may be divided into five to eight stages, observed by Nagahama (1983), West (1990), Fishelson et. al. (1996), Unal et. al. (1999) and by Gokçe et. al. (2003).

In present study changes in wall of the ovary, morphology of ova, number of ova was observed in different stage of maturity. Similar changes in developing oocytes were described for several species of teleosts by Grau et. al. (2009), Lubzens et. al. (2010) and Mohamed (2010) including changes in the size of the gonad and oocyte,

In present study gradual morphological changes in nucleolus and follicular epithelium was also observed in different stages of oocyte maturity. Nucleolus changes found by Thiry and Poncin (2005) and follicular epithelium by Quagio-Grassiotto and Guimaraes (2003) in developing oocyte. In present study development of the yolk in maturing oocyte has also noted. Similarly the development of the yolk also observed by Hartling and Kunkel (1999) which confirm our observation.

According to Schulz and Miura (2002) and Maldonado-Garcia et. al. (2005), teleost testis exhibited tremendous variations in structure, spermatogenic pattern and maturation during testicular cycle. In the present study, spermatogenesis was divided

according to size difference and to the occurrence of new structures easily recognizable during the different maturation of spermatogenic cells. These cells are spermatogonia, primary spermatocyte, secondary spermatocyte, spermatid and spermatozoon.

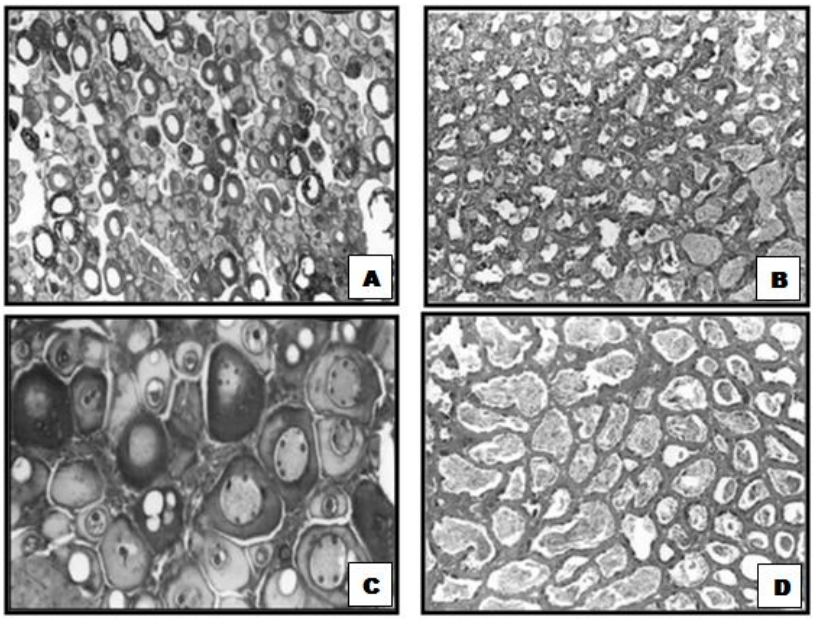
Development of sperm or milt in fish in accordance with Shein et. al. (2004) passes through multiplication stage, growth and maturation stages. Those in their recovering-spent stage are sexually mature but reproductively inactive. These reports supported by the study conducted by Brown-Peterson et. al. (2007). According to Bucholtz et. al. (1964), mature spermatozoa are seen aggregated in the lumen of testicular lobules without any regular arrangement, they begin to aggregate in the lumina even at the early stage when many of the germ cells still remain immature and do not reveal any connection with the intralobular somatic cell elements or Sertoli cell homologues.

CONCLUSION

From present study we can conclude that *Labeo dyocheilus* exhibit seven maturity stages in both male and female gonads. Histologically male and female fish gonads are differ but show developmental similarity. Here we also conclude that the male and female fish show similar kind of maturity stage in similar month. So testis and ovary attain maturity phase and spent phase in the same season and month.

ACKNOWLEDGMENTS

The author acknowledges the LSRB-DRDO (R&D) New Delhi organization for financial assist and FRDL for Laboratory as well technical support.



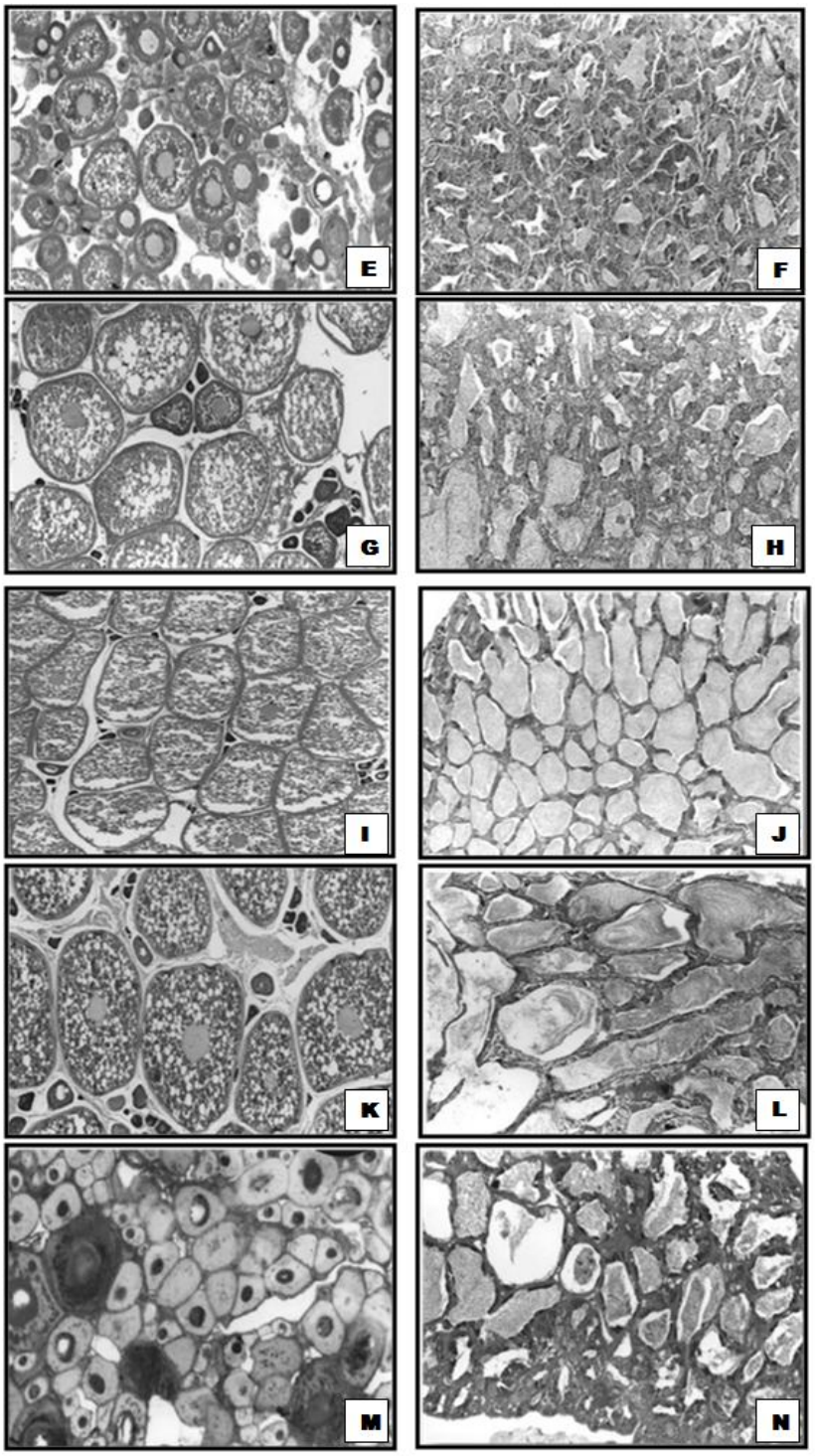


Figure 1- Stage I - Immature or Virgin (A= Ovary, B= Testis), Stage II - Maturing Virgin (C= Ovary, D= Testis), Stage III - Developing (E= Ovary, F= Testis), Stage IV – Maturing (G= Ovary, H= Testis), Stage V - Ripening (I= Ovary, J= Testis), Stage VI - Spawning or Running (K= Ovary, L= Testis), Stage VII - Spent (M= Ovary, N= Testis).

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