

Dietary manipulations and hormonal biotechnology in advancing gonadal maturation for quality seed production of Indian major carps and catfish

A.K. Pandey

ICAR-National Bureau of Fish Genetic Resources, India

The steadily growing importance of culture fisheries during the recent years has stimulated to improve the techniques necessary for securing the basic requirement, production of young ones (fry and fingerlings) for stocking. Therefore, the artificial propagation technique needs constant refinement for obtaining quality fish seed at the desired times of year. Recent advances in fish endocrinology have led to a better understanding of the hormonal factors involved in the control of gamete production, mode of their action and regulation of secretions during different phases of reproductive cycle. Environmental stimuli like photoperiod and temperature are perceived by the brain which releases gonadotropin-releasing hormone (GnRH). Though GnRH appeared first in cnidarians (coelenterates), it has also been recorded from molluscs, echinoderms and protochordates. This neuro-peptide (10 amino acids) has also been reported from non-hypothalamus tissues where it perform autocrine/paracrine functions.

With evolution of hypothalam-hypophysial-gonad (HPG) axis, GnRH plays pivotal role in neuroendocrine regulation of reproduction in chordates. It binds specifically to receptors in the pituitary gonadotrops and stimulates secretion of gonadotropic hormones (GTh-I, II). The circulating GTh-I functions at the target site in two ways- it induces synthesis and secretion of estradiol-17 β during pre-vitellogenic phase which, in turn, induces vitellogenesis or yolk production during post-vitellogenic phase, GTh-II triggers synthesis and secretion of maturation-inducing hormone, 17 α ,20 β -dihydroxyprogesterone (17,20-P) which is responsible for the final maturation leading to ovulation and spermiatioin. The recent identification of three GnRH isoforms (GnRH-1, GnRH-2 and GnRH-3), kiss proteins and two kiss genes (kiss-1, kiss-2) and two kiss receptors ((GPR-54)-kiss-1r and kiss-2r as well as cytochrome P450 aromatase gene (CYP19) in brain and gonads (ovary and testis) have given better insight into the mechanisms of hormonal interactions in fish reproduction. Further, role of pheromones are also gaining importance during advanced phases of reproduction involving the synchronization of maturity, attraction of prospective mates, triggering spawning behavior

and release of gametes.

Role of nutrition in broodstock management for quality seed production in fishes has been appreciated during the recent years. Success of induced breeding depends on proper gonadal maturation because fishes reared without adequate food supply do not show full maturity. Also, the breeding of females and males do not synchronize under improper rearing conditions. Dietary as well as hormonal treatments have resulted in advancement of maturity in the Indian major carps (*Catla catla*, *Labeo rohita* and *Cirrhinus mrigala*) and catfish (*Heteropneustes fossilis*) by 2 months under pond conditions giving scope for re-maturation and multiple breeding of the same fish for better gamete output. The catfish (*H. fossilis*) has been successfully bred for the four times from April to November under hatchery conditions through hormonal and dietary manipulations. Maternal treatments (injections/dietary) of thyroxine (T₄) to broodstock of these fishes improved survival and quality of the gametes. Interestingly, stocking together (both sexes) of broodstock of Indian major carps and catfish during breeding peak led to better induced spawning success and gamete output.

Feed utilization parameters such as weight gain percentage, specific growth rate, feed conversion ratio (FCR) and feed efficiency ratio (EER) were also improved in fry and fingerlings of these fishes reared on the diets supplemented with thyroxine (T₄). Growth and survival of *H. fossilis* larvae were also enhanced following thyroxine (T₄) and cortisol treatments during the early days of rearing. Modern fish industry is highly specialized exploring more and more possibilities to manipulate reproduction. In spite of all the recent advances in the reproductive physiology and nutrition, we are still far behind to understand the basic mechanism (s) involved in the process of fish propagation in nature. Altering sexual cycles, induction of advanced and delayed maturation, ovulation and spermiatioin as well as artificial fertilization are to be practiced for production of quality gametes for the expansion of aquaculture.

Dietary manipulations on gonadal growth of carps

Indian major carps (Catla catla, Labeo rohita and Cirrhinus mrigala) fed on semi-balanced diet supplemented with lysine and methionine (0.5%) (crude protein 28%) attained maturity by end of April and were bred successfully with ovaprim (sGnRH+Domperdone) (male 0.2 ml/kg body weight and female 0.4 ml/kg body weight) with 96% fertilization and 85% hatching success.

Hormonal manipulation in the Indian major carps

- Even low doses (0.1-0.2 ml/kg body weight) of ovaprim/ovotide given before 15 days of induced spawning improves the quality and quantity of gametes in the Indian major carps, silver carp (*Hypophthalmichthys molitrix*) and grass carp

(*Ctenopharyngodon idella*).

- Maternal thyroxine hormone administration improves the quality of egg production in Indian major carps and catfish.
- Thyroxine and cortisol (bath treatment) enhances metamorphosis and survival in the larvae of carps and catfish.

Biography: A K Pandey has completed his PhD (Zoology, Comparative Endocrinology) from the University of Gorakhpur in 1990. He is currently the Principal Scientist at National Bureau of Fish Genetic Resources (ICAR), India. He has published 248 research papers in journals of repute. Most of his papers are widely cited by eminent scientists of the world. He is also the Editorial Board Member of a number of national journals.

Email: akpandey.ars@gmail.com