CHAPTER 5

General Discussion

Common carp is a native fish species of Eurasia and they have been now successfully introduced to different regions of the Americas, Oceania, Africa, Asia, Europe and Australia (Koehn, 2004). The wild common carp strains found in different regions of world have typical geographical distributions with relation to separate genealogical lineages. Various studies based on genetic markers showed certain strains of common carp are limited to some particular geographical locations. This facilitated to understand microevolution and speciation of a species in its geographic context. Different studies indicated the presence of a number of strains of common carp in different countries of the world. The Cyprinus carpio communis strain was introduced in India in 1959 (Alikunhi, 1966). In Indian aquaculture industry common carp plays an important role in meeting the demand for fish. In the present studies, genetic variability of the Cyprinus carpio communis strain in different geographical regions of India was surveyed through mitochondrial DNA analysis which results the presence of five different haplotypes within the strain. This phylogeographic studies indicated that in various geographical regions of India the fish undergoes some changes in their genome as found in the mitochondrial DNA analysis. The study also encompasses analysis of certain proximate biochemical parameters of genetic haplotypes obtained from Cyprinus carpio communis sampled from different regions of India. In northeast region of India from where a large number of samples were analyzed found to have three haplotypes of the C. c. communis strain. The results obtained in the study are in agreement with the different phylogeographic studies based on different molecular marker done in different
regions of the world where it has been found that the *Cyprinus carpio* has highly divergent groups of haplotypes in various countries (Gross *et al.*, 2002; Kohlmann *et al.*, 2003; Memiş and Kohlmann, 2006; Imsiridou *et al.*, 2009). The summery of the studies are listed below-

1. The exotic fish *Cyprinus carpio communis* population in India is genetically diverged.

2. The genetic divergence of *Cyprinus carpio communis* has been observed through sequencing and analysis of partial Cytochrome b gene which results five genetic haplotypes: AsDhu1, TriGum, MizKo1, UPall2 and KarTuR,

3. The genetic variants (or strains) obtained are found to be distributed differently throughout the country. The distributions of the haplotypes were found to have relation with geographical location. But one variant/haplotype (AsDhu1) was commonly found and available in all over India which may be original founding strain. The haplotype “TriGum” was found in Assam and Tripura, the haplotype “MizKo1” was found in Mizoram and Meghalaya. The remaining two haplotypes namely “UPall2” and “KarTuR” were found in Uttar Pradesh and Karnataka respectively.

4. The haplotypes obtained in this study have different frequencies; the percentage of common haplotypes AsDhu1 is 62%. The percentage of other four haplotypes namely MizKo1, KarTuR, UPall2, TriGum are 11%, 10%, 9% and 8% respectively.

5. While comparing with GenBank sequences, the haplotype KarTuR found to have similarity in the respective part of mitochondrial DNA (partial cytochrome b) with the GenBank sequences of other country (USA).
6. The highly divergent mitochondrial haplotype KarTuR was also found to have differences in proximate biochemical compositions from other haplotypes obtained in the study.

7. The amino acid profile showed significant differences among the different haplotypes of *Cyprinus carpio communis*.

8. The fatty acids in five different genetic variants of *Cyprinus carpio communis* differ significantly.

**Implications of this study**

Sustainable management of genetic resources of a food fish species require detailed investigation of the different aspects of the species. The increasing development of common carp farming in India requires greater understanding of the genetic status of the popular stocks *Cyprinus carpio communis*. To this end an initial study of genetic variation within and among populations using mitochondrial markers was undertaken. Thereafter the fishes showing genetic variations (haplotypes) were further analysed for evaluation of proximate biochemical composition. This study provided useful insights into the intra population variation of *Cyprinus carpio communis* strain in different geographical regions of India with respect to occurrences of micro mutational changes in the genome. The genetic study is also important for the exotic fish species like common carp which is now regarded as invasive pest species in some countries of the world. The *Cyprinus carpio* has high fecundity and it is easy to rear in different environmental conditions, it become more suitable for culture; but the various studies suggest that the species may effect on some indigenous fish populations by initiating changes in gene make up of that fishes through hybridization and introgression. Besides the genetic cause, they may also come to competitions with other aquatic species for
food and shelter in natural aquatic bodies. The most important finding of this study is that the *Cyprinus carpio communis* population in India is now available in a genetically diverged form. As there is no previous DNA study for common carp from India, these results provide initial data for future genetic study which help in the future of common carp culture in India.

**Future research**

There is ample scope for further genetic/DNA studies on common carp in India. Genetic analysis with more markers and samples covering throughout India still need to be performed to formulate a good genetic management policy for the *Cyprinus carpio communis* strains used in India. For better understanding of the world’s most cultured fish species the various genetic studies including genetic mixing or hybridization with other related fish species to be studied. Further, the genetic divergence study may encompass control region of Mt DNA, analysis of polymorphic microsatellite and other nuclear DNA. Besides allozyme study and MHC polymorphism study can be done for population divergence study. As the common carp become identified as pest species in some countries (e.g. Australia) the detail impact of invasive characters are to be studied in different natural aquatic bodies including rivers and lakes or wetland in India.