SUMMARY

Chapter 1.

The histochemical localization and distribution of fat in the lateral line muscle of a number of marine and freshwater fishes was studied. Most of the intracellular fat was found to be located in the mitochondria. On the basis of diameter and fat content, three muscle regions (red, intermediate and white) having different fibre types were distinguished. The relative distribution of these fibre types was studied in the three regions. In some fishes all the three regions were present whereas in the rest the intermediate region was absent. In each of these regions, the number of fibre types was found to vary with respect to the different fishes studied. On the basis of these characteristics the fishes studied have been classed into two groups and the significance of these variations is discussed.

Chapter 2.

The histochemical demonstration of glycogen and certain glycolytic and pentose cycle enzymes in the red, intermediate and white fibres of a fresh water fish, Cirrhina mrigala has been made. UDPG glycogen synthetase was found to be located in the sarcoplasmic reticulum. A correlation between the glycogen content and the levels of phosphorylase and UDPG glycogen synthetase activity was revealed. The red fibres contained higher concentrations of glycogen and the two enzymes, thereby indicating that they are well adapted for synthesizing as well

as utilizing glycogen. The occurrence of the pentose cycle dehydrogenases in the muscle suggested the possibility of this shunt being used for the generation of NADPH(TPNH) for fatty acid synthesis.

Chapter 3.

The histochemical localization of fat and some of the enzymes connected with fat metabolism was carried out in the red, intermediate and white fibres of the freshwater fish, Cirrhina mrigala. The red fibres were found to be richly loaded with fat, lipase and the oxidative enzymes. Acetyl cholinesterase was present in larger amounts than butyryl cholinesterase. It is concluded that the red fibres are well adapted for aerobic metabolism involving mainly the oxidation of fat for energy.

Chapter 4.

Quantitative studies on the fat and glycogen contents and the enzymic activity (lipase and succinic dehydrogenase) have been carried out in the red and white muscles from three different regions along the body of the fishes, Labeo rohita and Labeo fimbriatus. It is concluded that there is a predominance of fat metabolism in the red muscle which has high fat content and lipase and SDH activity unlike the white muscle which is adapted for a predominantly glycolytic metabolism. The high glycogen content of the red muscle is suggested to be for utilization during periods of low activity of the fish when there is a shift from oxidative metabolism to glycolytic. The significance of the regional differences in

the physiology of the red and white muscles in the body of the fish is discussed.

Chapter 5.

The distribution and concentration of fat and glycogen and the localization of the enzymes, lipase and succinic dehydrogenase was studied histochemically in the red, intermediate and white muscle regions of the fish, Labeo rohita. The levels of the metabolites as well as of the enzymes studied, were found to be higher in the fibres of the red muscle. The capacity for in vitro oxidation of the fatty acid (butyrate) by whole homogenates of the red and white muscles separately was assessed in three fishes of the Family Cyprinidae. The red muscle was found to oxidize fatty acids readily.

Chapter 6.

The lipase and succinic dehydrogenase activities in the various subcellular particulate fractions of the red muscle of two carps, L. fimbriatus and C. mrigala, were determined. Significant differences in the activities of both the enzymes in all the fractions as well as whole homogenates, were obtained. In both the fishes, highest lipase activity was recorded in the soluble fraction and least in the mitochondrial. The activity in the microsomal fraction of C. mrigala was considerably low as compared to that of L. fimbriatus. As regards SDH activity, the highest concentration of the enzyme was found to be in the mitochondr-

ial fraction and least in the microsomal and soluble fractions in the case of C. mrigala. In L. fimbriatus on the other hand, maximum SDH activity was obtained in the soluble fraction. The significance of these findings is discussed.

Chapter 7.

A method which is an advance over the existing methods for the histochemical demonstration of lipase activity in muscle, using 'Tween 85' as substrate and alizarin red S as stain for the calcium soap formed, is described. Lipase has been localized in the mitochondria of the fish trunk and pigeon breast muscles.

Chapter 8.

Sarcotubular ATPase activity was demonstrated histochemically at different pH, in unfixed sections of the pigeon breast and fish muscles and also of the rat diaphragm. At acidic pH levels, without the addition of any activator, a higher sarcotubular ATPase activity was obtained in the white fibres where the sarcoplasmic reticulum is more elaborate and better developed. The activity obtained at neutral pH required the addition of a sulphydryl compound (cysteine) to stimulate the reaction. It is concluded that in skeletal muscle both acid and neutral ATPases are present. The optimum pH for acid ATPase was found to be 2.5 and for neutral ATPase 7.2. It is suggested that the higher sarcotubular acid ATPase activity in the white glycogen utilizing fibres is an adaptation to function under lower pH conditions due to possible lactic acid accumulation.

Chapter 9.

Increased Acid ATPase activity was histochemically demonstrated in the stimulated frog gastrocnemius muscle. The enzyme activity increased with the duration of stimulation (10 to 30 minutes) but began to decline with 60 minutes stimulation.