# SUMMARY


## CHAPTER 1

That the pigeon pectoralis consists of two distinct types of fibres, red and white has been known since long. The red fibres have been characterized as narrow in diameter, fat-loaded, studded with mitochondria and containing high concentrations of lipase and oxidative enzymes, thus adapted for an aerobic metabolism using fat as the chief energy fuel, whereas the white ones as broad in diameter, glycogen-loaded and containing high concentrations of glycolytic enzymes but only little lipase and oxidative enzymes and few mitochondria, thus adapted for an anaerobic metabolism using glycogen as the chief fuel. The two distinct types of fibres in the pigeon pectoralis form the basic pattern in the structural and cellular organization for a survey of the pectoralis muscles of various birds discussed in Chapter 2.

## CHAPTER 2

The cellular organization of the pectoralis muscle in various birds was studied. On the basis of the distribution pattern of the three basic fibre types red (R), white (W) and intermediate (I), the pectoralis muscles of birds investigated have been classed into six groups: 1. Fowl type (W, I and R fibres), 2. Duck type (R, W and I fibres), 3. Pigeon type (R and W fibres), 4. Kite type (I fibres), 5. Starling type (R and I fibres) and 6. Sparrow type (R fibres). In the fibre

composition shown in parentheses above, the fibre types are mentioned in the order of predominance. The variations in structure are correlated with function.

CHAPTER 3

The supracoracoideus muscles of various birds were studied with respect to their fibre composition and were characterized into nine groups: The Fowl, Kite, Hawk, Owl, Pigeon, Egret, Swift, Sparrow and Hummingbird types.

CHAPTER 4

The pectoralis and supracoracoideus muscles of various birds belonging to different orders were examined histochemically in order to assess the fat load in the various fibre types. The amount of fat present as indicated by the intensity of staining was assessed by visual observation under the microscope. An attempt was made to correlate the fat load in the various fibre types in the muscle with the activity of the muscle.

CHAPTER 5

A study was made on the fibre composition of the flight muscles, pectoralis major and pectoralis minor of the bats Hipposideros speoris, Pteropus giganteus, Sctophilus heathi, Pipistrellus ceylonicus,and Pipistrellus mimus. It was found that the three different types of fibres the red, white and intermediate which are characteristic of the two avian breast muscles, pectoralis and supracoracoideus are also represented in the bats.

Based on the fibre diameter and/or the fat content and

SDH activity, the pectoralis major of the different bats could be classed into three categories: Group 1 - red and white fibres, Group 2 - red and intermediate fibres and Group 3 - red fibres only. The pectoralis minor muscles could also be classed into three groups: Group 1 - red, white and intermediate fibres, Group 2 - red, intermediate and white fibres and Group 3 - red and intermediate fibres.

The fibre composition of the bat flight muscles are compared with those of birds and the possible relationship between the fibre composition and the mode of flight is discussed.

CHAPTER 6

Diurnal variations in the lipid and glycogen contents in the pectoralis muscle of the migratory starling (Sturnus roseus), were studied in the premigratory (March/April) and postmigratory (August) periods.

Glycogen levels in the evenings were found to be higher than in the mornings, both in the pre- and postmigratory periods. The increase in glycogen during the day is attributed to the increased glycogen synthetase activity. It is also suggested that the reduction of glycogen in the muscle during night is due to its conversion to fat which takes place in the night.

Fat levels on the contrary were found to be higher in the mornings than in the evenings. The increase in the fat content noted in the mornings, is explained as due to the utilization

of the metabolite for energy. In the last week of April just prior to migration the fat content recorded was more or less the same for morning and evening thereby indicating that fat is not metabolized for energy in the day time during this period. It is suggested that the energy supply during this period comes from the complete oxidation of pyruvate.

CHAPTER 7

It has been observed that pigeons subjected to a cold stress of 2 ± 1°C for 12 hours could withstand it without special metabolic effort. This is attributed to the fact that feathers serve as good insulators against loss of body heat. However, pigeons defeathered in the region of the pectoralis muscles exposed to the same stress conditions showed a reduction in the glycogen content of liver and the pectoralis muscle thereby indicating that glycogen is used as a fuel for thermogenesis.

CHAPTER 8

The glycogen content of the pectoralis major muscle of the bat (Hipposideros speoris) was found to be greater and the fat content slightly less in the morning unlike the condition observed in the pectoralis muscle of a bird such as the starling. This difference between the bird and the bat muscles is attributed to the nocturnal habit of the bat.

CHAPTER 9

The flight muscles viz. pectoralis and supracoracoideus of a number of representative flying and non-flying birds were

investigated in order to study the localization and distribution of phosphorylase.

In the activity of flying birds like the Rosy Pastor, Purple Moorhen and Vulture with flapping flight in the ~~former~~ first two and soaring in the latter, the level of phosphorylase in the pectoralis is considerable in the W or I type fibres respectively, indicating the utilization of glycogen as the chief fuel in these fibres for muscular activity.

The non fliers on the other hand eg. the Domestic Fowl and Guinea Fowl possess appreciable amounts of enzymatic activity uniformly distributed in all the three fibre types W, I and R of the pectoralis muscle with the exception of Domestic Duck ( a non flier) with R, W and I type of fibres in the pectoralis possesses an identical pattern of phosphorylase distribution as in the pigeon (an active flier), suggests that in the Domestic Duck the loss of flight might be secondary.

The supracoracoideus muscle of all the birds studied showed a higher content of the enzyme in the W type fibres and less in the R type with the exception of the Domestic Fowl and Guinea Fowl where the higher activity of the enzyme was obtained in all the three types of fibres like the pectoralis.

The significance of these observations is discussed in these birds.

CHAPTER 10

It was found that all the three types of red, white and

intermediate fibres present in pectoral muscles of birds were also present in the gastrocnemius muscle in the various birds studied.

None of the gastrocnemius muscles showed a predominance of the red fibres.

The gastrocnemius muscle of none of the birds studied showed the presence of only two types of fibres, (red and white) nor one type only (red or intermediate) as observed in the pectoralis muscle of birds.

The gastrocnemius muscles in the birds studied were found to fall into groups, one having a predominance of white fibres and the other of intermediate fibres. The latter type is characteristic of birds using their legs for sustained activity such as swimming, running etc.

Considerable overlapping was found in the diameter of the three types of fibres in the different birds studied.