CHAPTER 1

HISTOLOGY OF THE ADIPOSE TISSUE OF VERTEBRATES

The fact that the histological structure of the adipose tissue has been studied less extensively than many other tissues was mainly because this was considered to be an inert tissue, a mere bag of fat, with little or no metabolic activity of its own. In recent years however, some valuable studies have been carried out. Fawcett (1952) made a comparative study of the histological structure of the brown and yellow adipose tissue of the rat and noted some significant differences in their structure. Few other mammals like rodents and many hibernators also possess these two types of adipose tissue. In a few cases like that of the rabbit, cat, and man, most of the brown adipose tissue present in embryonic stages undergoes changes in their typical structure and tends to resemble the yellow adipose tissue in adult life (Selye and Timiras, 1949; Sidman, 1956). However, in vertebrates other than mammals the brown adipose tissue appears to be lacking and in these animals the yellow type is the only one present.

In this chapter is presented the results of a general histological study of the adipose tissue of the frog (Rana tigrina), lizard (Calotes versicolor), pigeon (Columba livia) and bat (Hipposideros speoris). The vascularity of the pigeon adipose tissue was also studied.

Material and Methods

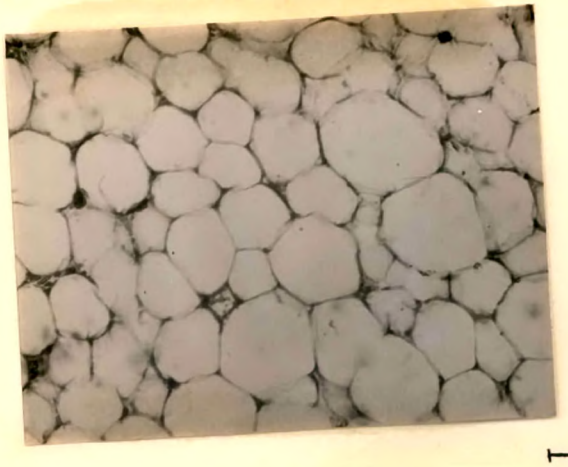
The material used in the present study was the visceral adipose tissue, except in the bat, where, subcutaneous adipose

tissue was taken, after decapitation of the animal. The visceral adipose tissue found in association with the reproductive organs in the frog and lizard and the same tissue covering the coils of the intestine in the pigeon; the subcutaneous interscapular brown adipose tissue and the yellow adipose tissue located on the lower lateral sides of the abdomen of the bat; were carefully severed and transferred to the fixative. The fixative used was Zenker's fluid (Gurr,1956). Small pieces of the tissue were fixed in the aforesaid fixative for 1 hour, washed in running water for the same time and dehydrated in the usual manner. Paraffin sections were cut at 10 μ and stained with haematoxylin and eosin. Few sections of the pigeon adipose tissue were stained with haematoxylin and van Gieson stain (Picro-Acid fuchsin, Gurr,1956) for the detection of collagen. For the study of the vascularity of the pigeon adipose tissue, 5 ml of India ink was injected in to the left ventricle of a live pigeon under ether anaesthesia. The pigeon died after a short time and was then fixed whole in 10% formalin for 24 hours. The adipose tissue was then removed and observations on its blood supply were made from frozen sections.

Observations and Discussion

Figure 1, 2 and 3 present the photomicrographs of sections of the adipose tissue of the frog, lizard and pigeon respectively, stained with haematoxylin and eosin. The cytoplasm is confined to the periphery of the cells, the inside being filled with a single fat droplet. The nuclei of the cells also lie at the periphery. Sections of the pigeon adipose tissue stained with haematoxylin and van Gieson stain revealed an abundance of collagen throughout.

The structure of the adipose tissue in these three vertebrates is more or less the same.



100μ

Fig. 1

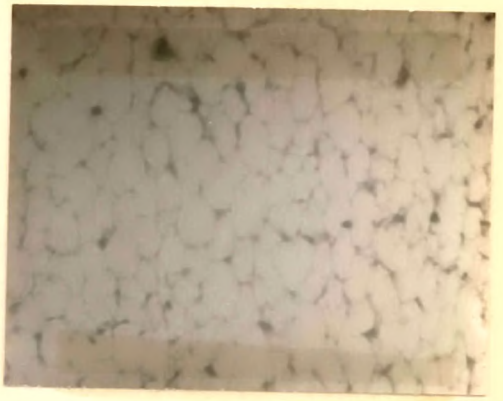
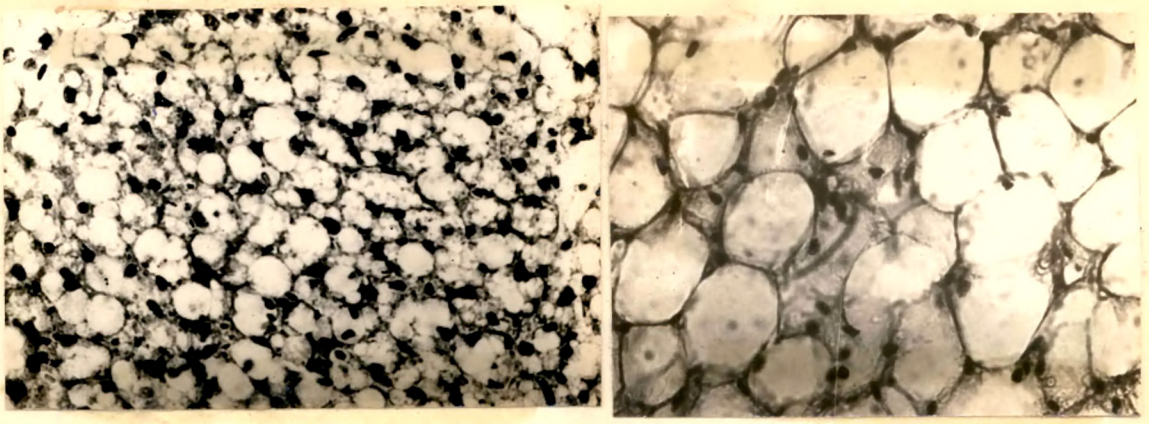


Fig. 2

Fig. 3

Fig. 1, 2 and 3 - The visceral adipose tissue of the frog, lizard and pigeon respectively, showing their histological structure. (Haematoxylin and eosin).

Figure 4 and 5 present the photomicrographs of the brown and yellow adipose tissue of the bat.



50μ

Fig. 4 Fig. 5

Fig. 4 and 5 - The brown and yellow adipose tissue of the bat respectively, showing their histological structure. (Haematoxylin and eosin).

In the brown adipose tissue the cells are smaller, the cytoplasm more abundant and nuclei more centrally situated. The fat droplets in the cytoplasm do not become confluent as is the case in the yellow type and hence the cytoplasm has a vacuolated appearence. The yellow adipose tissue cells are many times bigger and their nuclei lie at the periphery. The brown and yellow adipose tissue are named 'multilocular' and'unilocular' respectively with reference to the number and size of the lipid droplets present in the individual cells. Thus the histological differences between the two types of adipose tissue are quite distinct. In structure both the brown and yellow adipose tissue of this bat more or less

resembles respectively the corresponding tissues of the rat, described by Fawcett (1952). The yellow adipose tissue of this bat and the rat (Fawcett,1952) closely resembles the adipose tissue of the frog, lizard and pigeon in structure and in these vertebrates, other than mammals, the yellow adipose tissue seems to be the only type present. There is disagreement as to whether the brown and yellow varieties are histogenetically distinct or otherwise. Sidman (1956) has reported that the brown variety does not differ fundamentally from the yellow in development and also contented that intergrades between them occur. Whatever this may be, in those animals where these two types of adipose tissue are found in adults also, they are distinct in their histological structure (Fawcett,1952; George and Eapen,1959), histochemical reactions (Fawcett,1952; Menschik,1953; George and Eapen,1959) and physiological response (Fawcett,1948).

Figure 6 presents the photomicrograph of the section of adipose tissue of the pigeon injected with India ink to reveal vascular distribution.

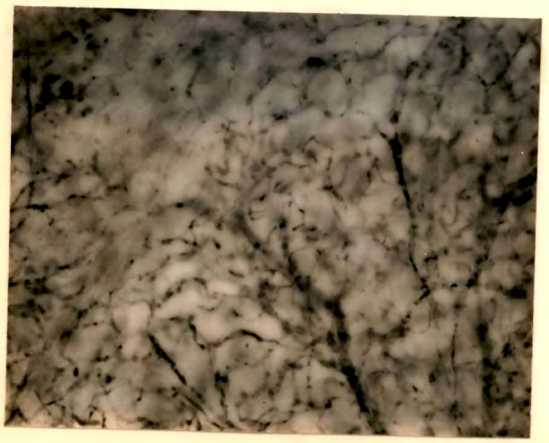


Fig. 6

Fig. 6 - The visceral adipose tissue of the pigeon showing an extensive capillary distribution.

There is a plentiful supply of blood to this tissue as could be seen from the abundance of the capillaries. The brown adipose tissue of the rat is reported to possess a higher capillary density than the yellow variety (Fawcett,1952). In the pigeon in which there appears to be only the yellow variety, the blood supply to this tissue is very rich. It should be of interest to note that Liebelt and Eastlick (1954) suggested that the adipose tissue be called 'fat organ' by virtue of its origin, structural and functional combination of mesenchyme cells and also due to abundant nerve supply to both the parenchyma and blood vessels.