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REGIONAL DISTRIBUTION OF GLYCOGEN, ACID AND ALKALINE PHOSPHATASE IN THE HEART OF *PTEROPUS GIGANTEUS* (LINN.)

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ABSTRACT
A detailed biochemical study has been made in the heart of *Pteropus giganteus* for glycogen and acid and alkaline phosphatase contents. Highest concentration of glycogen and both the phosphatases was observed in the right atrium and basal region of the ventricles, suggesting more activity in these regions. Apical region of the ventricle represented minimum content of glycogen and phosphatases.

KEYWORDS: Glycogen, acid phosphatase, alkaline phosphatase, heart, *Pteropus giganteus etc*.

INTRODUCTION

The physiological metabolism of the cardiac glycogen differs from that of the liver or striated muscle, therefore, considerable controversy has arisen concerning its specific role in the cardiac tissue. Attempts have been made to correlate the glycogen content of the various chambers of the heart with their inherent rhythmicity (Davis and Francis, 1941), excitability (Lee, 1951) or cycle lengths (Merrick, 1957). Kokubun *et al.* (2009) observed an increase of cardiac glycogen under fasting condition in rats. Martins and Azevedo (2008) observed high alkaline phosphatase activity, mainly tissue-nonspecific in rat heart. A different approach to the regional metabolism of the heart was initiated in the present investigation. An analysis of the special distribution of glycogen and acid and alkaline phosphatase at various sites from apex to base is made in the heart of Indian flying fox *Pteropus giganteus*. In addition the concentration of glycogen and phosphatases in the conduction system of the heart is compared with that of the myocardium.

MATERIALS AND METHODS

Animals were procured from local sources and acclimatized to the laboratory conditions for 6 days. After decapitation, thorax was opened and hearts were divided into eleven parts i.e. right and left atria, basal, middle and apical regions of each of the right ventricles, interventricular septum and left ventricle. Tissue was carefully weighed on the monpan eletctric balance. For quantitative estimation of glycogen and acid and alkaline phosphatase, Seifter *et al*. (1950) and Fiske and Subbarow (1925) techniques were adapted respectively.

OBSERVATIONS

Table -1 represents regional distribution of glycogen and phosphatase concentration in the various cardiac chambers of *Pteropus giganteus*. Highest activity of glycogen (64.37 ± 0.56), acid phosphatase 163.75 ± 12.29) and alkaline phosphatase (256.25 ± 27.32) is noted in the right atrium, while other regions of the heart depict variations for their glycogen and phosphatase contents.

TABLE 1: Regional distribution of glycogen and acid and alkaline phosphatase in the heart of *Pteropus giganteus* (Linn.)

Region	Glycogen (mg/100gm tissue)	Acid Phosphatase (µgP/100gm/h)	Alkaline Phosphatase (µgP/100gm/h)
Right Atrium	64.37 ± 0.55	163.75 ± 12.29	256.25 ± 27.32
Left Atrium	60.87 ± 0.27	151.25 ± 15.34	251.25 ± 15.94
Right Ventricle			
Base	53.88 ± 0.47	85.00 ± 11.67	111.25 ± 10.21
Mid	49.23 ± 0.66	61.25 ± 10.21	103.75 ± 17.19
Apex	44.98± 0.88	31.25 ± 6.12	83.75 ± 17.19
Intra ventricular Septum			
Base	50.57± 1.06	87.50 ± 4.99	247.50 ± 31.20
Mid	47.15± 0.76	68.75 ± 14.03	141.25 ± 11.40
Apex	38.06± 0.66	65.00 ± 17.61	133.75 ± 6.51
Left Ventricle			
Base	33.49± 0.46	98.75 ± 18.14	183.75 ± 21.83
Mid	26.63± 0.41	57.50 ± 15.45	163.75 ± 17.97
Apex	21.83± 0.88	30.00 ± 8.29	93.75 ± 16.20

DISCUSSION

According to Bloom and Knowlton (1953), amount of the TCA soluble glycogen fraction present in the tissue depends on the state of nutrition of the animals. Blount (1967) and Poland and Trauner (1973) observed decreased content of glycogen in the hearts of exercised animals. George and Scaria (1957) suggested that, `in per unit weight of the heart muscle, the energy expenditure is more in small animals because they have high heart rate than the larger ones.' Davis and Francis (1941) have shown that the concentration of the total glycogen in frog and salamander is lowest in the sinus, higher in the atria and highest in the ventricle and bulbus, an order which is the inverse of intrinsic rhythms of these chambers. In mammals the reverse is true (Davis *et al*., 1947), since the atria contain more glycogen per unit weight than do the ventricles. Weisberg and Rodbard (1958) noted highest concentration of glycogen in the atria, lowest in the left ventricle and intermediate in the interventricular septum. According to them, if the glycogen concentrations were related to the cycle length alone, all the chambers of a heart might be expected to have similar proportions of this material, since they beat normally at the same rate. In the present study, different regions of the heart depict variations in the glycogen concentration. It is more in the right atrium than the left one. The distribution of glycogen in the various regions of the ventricle is also not uniform and it decreases from base to the apex in the right and left ventricular walls and the interventricular septum. The apical glycogen contents were considerably low. The maximum amount of glycogen in the basal region of the ventricle may be perhaps due to the compact nature and presence of the atrioventricular bundle in this region. Moreover this region is physiologically more active than other regions as the contraction of this region forces the blood into the aorta, while the apical region is not so much functionally active, and therefore, shows minimum glycogen content. No noteworthy reduction in cardiac glycogen is observed even after considerable body load (Schiebler, 1955). Glycogen may be considered as an energy rich structural constituent of the tissue which can be released when there is a lack of oxygen and nutrients. Eccles *et al.* (1960) considered that some reserve of myocardial glycogen is severely depleted in anoxic conditions. Present study reveals that in *Pteropus giganteus,* due to flight adaptations, energy expenditure is increased and therefore there is a possibility that the glycogen serves as a reserve food which at the time of heavy exhaustion is utilized for the energy production.

According to Fischer *et al.* (1977) histochemical techniques for the demonstration of enzymatic activity revealed inter and intra species variations in the vascular metabolism. El-Maghraby and Gardner (1968) divided a number of species on the basis of alkaline phosphate activity into those with high endothelial activity, including the chicken and those such as the rat with high adventitial content. Mota *et al.* (2008) observed a high total alkaline phosphate activityin the heart of rat. Lojda and Zemplenyt (1961) believed that an alkaline phosphatase activity is present only in the vasa-vasorum of the adventitia while acid phosphatase gives a distinct positive reaction of the endothelium and muscle cells of media of rabbit aorta. Fouquet (1961), Wegmann and Fouquet (1961) and Pinto *et al*. (1974) could not describe any reactivity of alkaline and acid phosphatases in the great vessels of mammals. Meijer and de Vries (1978) reported higher acid phosphatase activity in the Purkinje fibers of bovine and porcine heart. The present study reveals high acid and alkaline phosphatase activity in the right atrium and basal region of the right ventricle, interventricular septum and left ventricle of *Pteropus giganteus.* This high content may be dependent on the region of the tissue taken. It is likely that the regions selected for the study contain more of the blood vessels as three precavals are opening in the right atrium and prominent coronary blood vessels are present in the basal region of the ventricle. The present study also reveals that alkaline phosphatase activity is found to be more than the acid phosphatase, as there is little lysosomal activity in the cardiac tissue.

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