CHAPTER 7

EFFECT OF COLD STRESS ON THE GLYCOGEN CONTENT OF THE PECTORALIS AND THE LIVER OF THE PIGEON

It is well known that homeotherms when exposed to cold are capable of maintaining their normal body temperature by metabolic heat production. In birds, feathers provide good insulation against cold and so birds could withstand severe cold. Scholander et al. (1950) observed that gulls can withstand the arctic winter without special metabolic efforts. The extraordinary tolerance to cold by domestic pigeons at -40° C was reported by Streicher et al. (1950). In rat, the liver and muscle are the chief sites where chemical thermogenesis takes place and glycogen is known to be utlized during cold exposure for heat production (Hensel and Hildebrandt, 1964). In the present study the changes in the glycogen level in the liver and the pectoralis muscle of the pigeon as a result of exposure to 2°C ± 1 for a period of 12 hours was studied.

In the previous chapter it was shown that there is an increase in the glycogen content of the muscle and liver of the Rosy Pastor towards migration. It was also shown that there is a decrease in glycogen in these tissues during night. The present study on the effect of cold stress was conducted with a view to find out if glycogen is utilized for thermogenesis.

MATERIALS AND METHODS

Healthy pigeons weighing about 260 to 270 gms were used

for the experiments. A set of three pigeons were used for each experiment. The pigeons were weighed and two of them were placed inside the refrigerator in a single cage with one of the pigeons defeathered in the region of the two pectoralis muscles. The temperature inside the refrigerator at the region where the cage was placed recorded 2°C± 1 . The pigeons were exposed to this temperature for a period of twelve hours from 8PM to 8AM. The third control pigeon with feathers intact was kept as room temperature for a similar period of time inside a similar cage. At the end of the experimental period (12hrs.) all the three pigeons were reweighed and were sacrificed. The blood was allowed to flow and a piece of muscle weighing about 200 mg. was cut from the central region of the pectoralis muscle (superficial layer). Similarly a piece of liver from the middle region was taken. The tissues were dropped into weighed tubes containing 3 ml of 10% KOH. The tubes were quickly weighed again to determine the weight of the tissue. The samples were digested in KOH, by heating. Glycogen was estimated by anthrone method according to Seifter et al. (1950) as described in chapter 6.

RESULTS

The results obtained are presented in Table 1.The significance of the differences in the percentage values of muscle and liver glycogen in pigeons subjected to the three different experimental conditions was tested by employing the 't' test.

Muscle glycogen:

The mean percentage of muscle glycogen was 1.575 in the

control pigeon and 1.25 in the pigeon under cold stress with the feathers intact. Though a slight decrease in the percentage of glycogen in the latter is seen from the mean values this difference was not statistically significant. In the defeathered pigeons under cold stress the glycogen level was found to be 0.855%. When compared to the glycogen level of control pigeons maintained at room temperature this difference was found to be highly significant at 1% level. The difference between the glycogen values obtained for the defeathered and normal pigeons exposed to cold stress (both kept in the refrigerator) was however, not found to be significant.

Liver glycogen:

The mean glycogen contents of the liver of control pigeons and pigeons exposed to cold with intact feathers were 3.03 and 3.091% respectively. There was no significant difference between these two values. The defeathered pigeons on the other hand had only 1.858% glycogen in the liver. This decrease was found to be significant at 5% level when compared to the control pigeons. The difference between the liver glycogen contents of defeathered and normal pigeons both kept in the refrigerator was also found to be significant at 5% level.

DISCUSSION

The results obtained show that there was no significant reduction in the glycogen content of both the liver and muscle on exposure of the normal (with intact feathers) pigeons to a cold stress of twelve hours duration at 2°C ± 1 . It is evident

that no chemical thermogenesis takes place in the pigeon under such circumstances. This finding is in agreement with the result obtained by Scholander et al. (1950) who showed that Gulls can withstand the cold in the arctic winter condition without any special metabolic efforts.

The significant role played by the feathers in this tolerance to cold is clearly demonstrated by the results obtained on exposure of pigeons defeathered in the pectoral region, to the same condition. It may be noted that the glycogen content of both the liver and muscle showed a marked reduction in the defeathered cold exposed pigeons from that of the normal control pigeons kept at room temperature. The difference in the glycogen content between the two pigeons exposed to cold, one with feathers and the other without, was significant in the case of liver. In the case of muscle, the present experimental data did not show statistically significant difference though the mean value of glycogen showed a reduction.

The enhanced rate of depletion of glycogen in the defeathered cold exposed pigeons clearly shows that it is utilized for metabolic heat production.

From the present experiments it is evident that under normal conditions, exposure to cold does not lead to chemical thermogenesis through the utilization of glycogen as fuel in pigeons. It should be emphasized that defeathering is not a normal situation which is obtained under natural conditions. Therefore it may be concluded that though the liver and the muscle of the pigeon have

the potentiality for chemical thermogenesis through glycogen under natural circumstances such a phenomenon does not occur at least not to a considerable extent. The feathers normally provide an adequate guarantee against cold exposure by providing an effective insulation.

TABLE 1

THE GLYCOGEN LEVELS IN THE PECTORALIS AND LIVER OF THE EXPERIMENTAL PIGEONS

Experimental conditions	Total body weight at 8PM	Total body weight at 8AM	Loss in body weight in percentage	Muscle glycogen in percentage	Liver glycogen in percentage
Pigeons kept in room temperature as control at 30°C ± 1°	273.906 ± 24.916	255.300 ± 24.40	6.52	1.5750 ± 0.6726	3.0311 ± 1.714
Pigeons with intact feathers kept in the refrigerator at 2°C ± 1°	264.747 ± 14.75	247.233 ± 14.24	6.49	1.2499 ± 0.6525	3.0908 ± 1.689
Pigeons defeathered in breast region in refrigerator at 2°C ± 1°	262.8 ± 25.177	242.33 ± 25.13	8.12	0.8546 ± 0.3693	1.8582 ± 0.7549

The values given are the mean and the standard deviation of fifteen experiments in each group.