CHAPTER VI

EFFECT OF PINEALECTOMY OR EXOGENOUS MELATONIN ON CARBOHYDRATE METABOLISM AND ISLET FUNCTION IN FERAL PIGEONS DURING THE NON-BREEDING SEASON.

Influence of pineal on carbohydrate metabolism has been demonstrated in fishes (Delahunty et al.,1978,1990; Delahunty and Tomlinson,1984), birds (Mihail and Giurgea, 1979) and mammals (Damian,1989; Murlidhar et al.,1983; Diaz and Blazguez,1986). Studies from this laboratory have fairly established the hypoglycemic and tissue glycogen depleting effects of both PX and exogenous M in pigeons during the breeding season. Seasonal studies in carbohydrate metabolism involving pineal activity have been carried out only in fishes and such studies have suggested differential effects of pineal and its hormone on blood glucose and tissue glycogen in different seasons (Delahunty et al.,1978). However, no such seasonal evaluation is made in other animals. In the course of present studies, it was observed that exogenous M administration during the breeding season to either intact or PX pigeons produced more or less similar effects on carbohydrate metabolism (Chapters II & IV). The above studies suggested some definite phase relationships between pineal activity and pancreatic hormones during the breeding season. The present study has

been designed to evaluate the effects of PX or exogenous M administration to intact birds on carbohydrate metabolism in the non-breeding season.

Materials and Methods :

Procurement and maintenance of pigeons and preparation of solution (melatonin) - as outlined in Chapter I.
Experimental set-ups - as in Chapter V.
Parameters and Methods of evaluation - as outlined in Chapter II.

Results : (Table-6.1; Figs.- 6A,B, .)

Blood glucose : The glycemic level of intact birds during the non-breeding season was relatively lower than in the breeding season. Both PX and exogenous M administration decreased the glycemic level significantly.

Hepatic and Muscle glycogen contents : The tissue glycogen contents were relatively higher in the non-breeding season. Both PX and M administration decreased hepatic and muscle glycogen content significantly.

Hepatic Phosphorylase and G-6-P'ase : Control birds have higher levels of activity of these two enzymes in the

Treatments	Blood Glucose (mg/dl)	Tissue Glycogen (mg/100mg Tissue)		Hepatic G-6-P'ase (u moles PO_4 released /mg Protein/15 min)	Hepatic Phosphorylase (ug PO_4 released/mg Protein/15 min)
		Hepatic	Muscle		
C	160.67 ± 19.99	3.26 ± 0.15	1.35 ± 0.17	2.15 ± 0.12	18.82 ± 1.91
PX	150.01* ± 18.12	2.22* ± 0.40	0.82* ± 0.07	1.45* ± 0.16	11.28* ± 1.53
M50	148.60* ± 17.96	1.89* ± 0.17	0.73* ± 0.04	3.77* ± 0.48	29.51* ± 2.19

Table 6.1: Alterations in blood glucose, tissue glycogen contents and activity levels of phosphorylase and G-6-P'ase in liver of PX or M treated pigeons in the quiescent phase (* = Significant at $P < 0.05$; values are $\bar{x} \pm SD$)

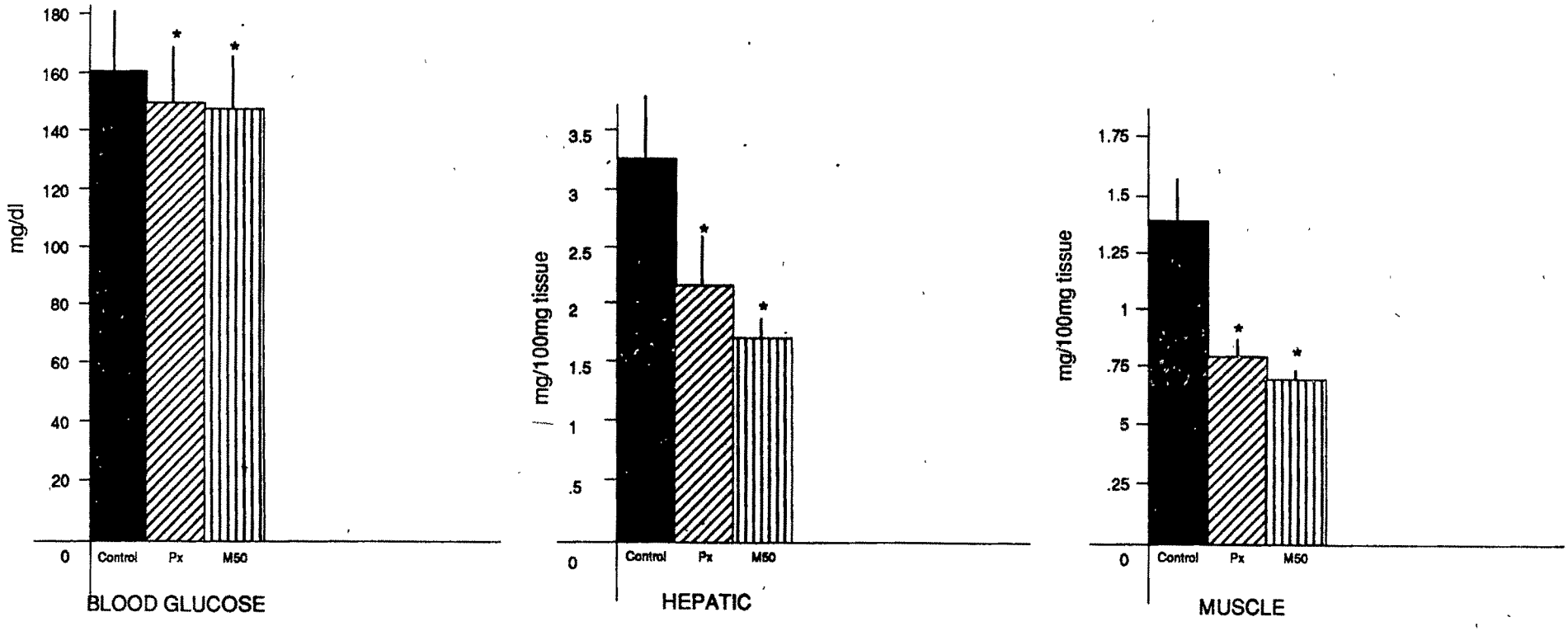

Fig. : 6A : Alteration in blood glucose and tissue (hepatic and muscle) glycogen content of P X or M treated pigeons in the quiescent phase.
(* Significant at $P < 0.05$, values are $\bar{x} \pm SD$).

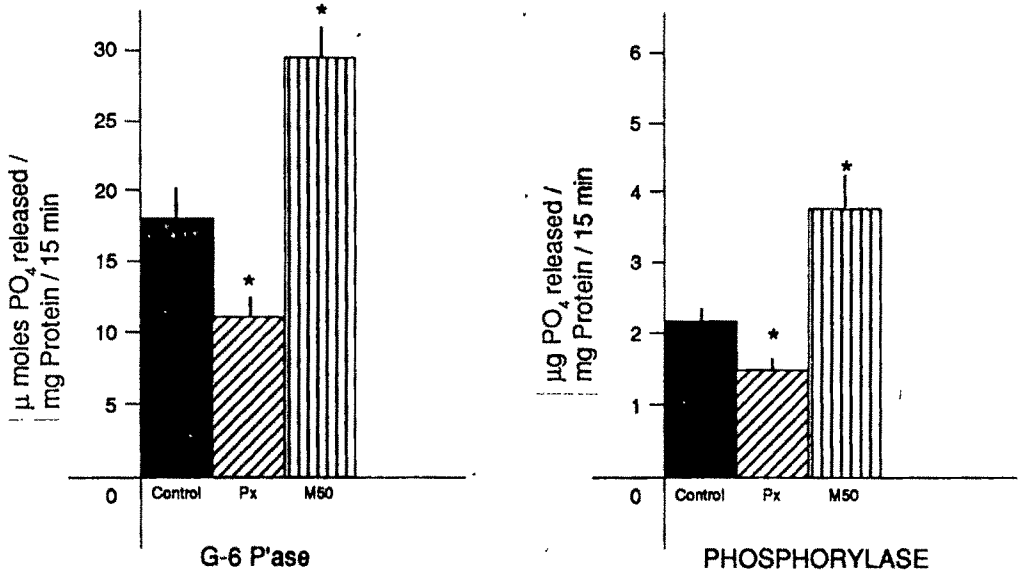

Fig. 6 B : Alterations in the activity levels of G-6-P'ase and phosphorylase in liver of PX or M treated pigeons in the quiescent phase. (* Significant at $P < 0.05$, values are $\bar{x} \pm$ SD).

non-breeding season. Whereas PX decreased the activity levels of these two enzymes, M administration increased their activity significantly.

Histological observation on Pancreatic islets :

Differential staining for A or B cells of pancreatic islets revealed significant degranulation of B cells in PX birds and degranulation of A cells in M treated pigeons.

Discussion :

The results of the present study suggest an independent hypoglycemic and tissue glycogen depleting effect of both PX and M. This is quite in contrast to the observation made in fishes showing independent and differential effects of PX or M administration on glycemic status and hepatic glycogen content on a seasonal basis (Delahunty et al.,1978). Previous observations showed similar season independent effect of exogenous M on the HHT and HHA axes but not on the HHG axis in both intact and PX pigeons (Chapters I, III and V). At the same time, PX affected these axes only during the breeding season and was without much effect in the non-breeding season (Chapters III and V). But the relationships between pineal activity and pancreatic hormones was identical in all seasons. In the non-breeding season also significant hypoglycemia and hepatic and muscle

glycogen depletion together with B cell degranulation have been observed after pinealectomy as in the breeding season.

Obviously, a consequence of pinealectomy at any time during the year in feral pigeons is to decrease the glucagon : insulin molar ratio which is indicated by the decrease in hepatic phosphorylase and G-6-P'ase activity. Therefore the increased glucose tolerance and insulin sensitivity suggested for breeding season (Patel et al.,1983; Ramachandran and Patel,1989) holds true for the non-breeding season as well. The mechanism of PX-induced tissue glycogen depletion and hypoglycemia seems to be due to reduced glycogenolysis coupled with suppressed glycogenesis and increased peripheral utilization of glucose as have been inferred earlier (Ramachandran and Patel,1989; Patel and Ramachandran,1992; Chapter II and IV). The increased phosphorylase and G-6-P'ase activity and the pronounced A cell degranulation in the pancreatic islets suggests increased glucagon secretion in response to exogenous M. The resultant increased glucagon : insulin molar ratio is responsible for the decreased tissue glycogen contents. However, the simultaneous decrease in the glycemic level is essentially due to increased withdrawal and utilization of blood glucose into other biogenic pathways involving lipids, proteins and ascorbic acid. Such a surmise was made earlier also based on the effects of exogenous M to intact pigeons

during the breeding season (Chapter II).

Overall, it can be concluded from the present studies that pineal can influence carbohydrate metabolism by its interrelationships with the pancreatic hormones which remain the same throughout the year irrespective of the seasons or breeding status.