SUMMARY

CHAPTER I

Comparative effects of melatonin (M), methoxytryptophol (ML), methoxytryptamine (MT) and parachlorophenylalanine (pCPA) have been studied in terms of gravimetric and histological changes in testis, adrenal and thyroid and serum hormone (T3, T4 and corticosterone) profile in the recrudescent phase of the feral pigeon, Columba livia. The study showed a common anti-gonadal effect of all the three pineal indoles as marked by spermatogenic arrest and degeneration of germ cells. Treatments with M resulted in adreno-cortical enlargement and medullary hypertrophy whereas ML, MT and pCPA induced medullary hypertrophy without having much influence on the cortex. Treatments with M and ML brought about colloid retention in the thyroid follicles while MT and pCPA induced colloid depletion and hypertrophy of the follicular epithelium. From the present study it can be concluded that pineal indoles as well as pCPA induce testicular regression in the breeding phase. However, the mechanisms of action appears to be differential and phase relationship between pineal, adrenal and thyroid are presumable.

CHAPTER II

Possible impact of pineal indoles (melatonin-M; methoxytryptophol-ML; methoxytryptamine-MT) and pCPA on carbohydrate metabolism in terms of hepatic and muscle glycogen contents, hepatic phosphorylase and G-6-P'ase and blood glucose level and pancreatic islet functions have been studied in the feral pigeon, Columba livia during the recrudescent phase.

Treatments with M and pCPA,induced hypoglycemia and tissue glycogen depletion; however, ML and MT treatments induced hyperglycemia and tissue glycogen deposition.Hepatic phosphorylase and G-6-P'ase activity increased with M treatment and decreased with ML, MT and pCPA. Pancreatic islet showed A cell degranulation with M, B cell degranalation with pCPA and increased granulation with both ML and MT treatments. These results have been taken to indicate definite influence of pineal and pineal indoles on carbohydrate metabolism by way of their influence on pancreatic hormone secretion and tissue sensitivity to them.

CHAPTER III

The present study was designed to see whether replacement

with exogenous melatonin (M) to pinealectomized (PX) pigeons could nullify the PX-induced effects on testes, adrenal and thyroid, in terms of their relative weights, histological changes and serum hormone (T3, T4 and corticosterone) levels in the breeding phase. It was seen that of the two doses of M employed (50 & 100 µg), it was only the higher dose which could negate the effects of PX on the hypothalamo-hypophysial-adrenal (HHA) and hypothalamo-hypophysial-thyroid (HHT) axes as denoted by the histomorphological changes as well as the serum hormonal profile. Both doses of M were unable to prevent the PX-induced suppressive effects on the hypothalamo- hypophysial-gonadal (HHG) axis. Thus the present findings suggest that M has independent ability to maintain HHA and HHT axes on one hand and HHG axis on the other hand by its differential effects. Also an optimum-lower threshold level of M for a critical duration is required to keep the HHG axis functioning in the reproductively active phase.

CHAPTER IV

The present study was designed to assess the effect of melatonin (M) replacement on carbohydrate metabolism in pinealectomised pigeons in the breeding season, in terms of blood glucose level, tissue glycogen contents, activity

levels of hepatic phosphorylase and G-6-P'ase, pancreatic islet functions and thyroid hormone level. Pinealectomy resulted in hypoglycemia and hepatic and muscle glycogen depletion together with B cell degranulation. Hepatic phosphorylase and G-6-P'ase activity was also decreased. Neither of the two doses (50 µg and 100 µg) used,seemed capable of preventing the PX effects on carbohydrate metabolism, though the higher dose to a certain extent was effective in attenuating the PX-induced alterations. Pinealectomy increased serum T4 level. Lower dose of M was unable to check this effect. In constrast,100 µg of M was capable of preventing the PX effects on the hypothalamo-hypophysial-thyroid (HHT) axis as indicated by the state of the thyroid follicles and serum T4 level. An overall consideration leads to the surmise that an optimum level as well as duration of M is necessary for normal homeostasis.

CHAPTER V

In the present study, the influence of pinealectomy (PX) or exogenous melatonin (M) administration to intact pigeons has been carried out in the reproductively quiescent phase, to assess their impact on hypothalamo-hypophysial-gonad (HHG), hypothalamo-hypophysial-adrenal (HHA) and hypothalamo-hypophysial-thyroid (HHT) axes. Neither PX nor M

administration had any effect on the testes. Though M administration showed increased adrenal weight with cortical enlargement, the serum B level was not significantly altered . However, M treatment brought about colloid retention in thyroid follicles and decreased serum T4 level. The present results tend to suggest that both PX and M have antigonadal effects in the quiescent phase as well. But, M seems to have suppressive influence on HHT axis and stimulatory influence on HHA axis, features conducive for gonadal functions. However, the inability of M to have any effect on gonad would suggest a possible refractoriness of the HHG axis during this phase.

CHAPTER VI

Effects of pinealectomy or exogenous melatonin administration on carbohydrate metabolism have been studied in terms of glycemic level, tissue glycogen contents, hepatic phosphorylase and G-6-P'ase activity and pancreatic islet functions in the feral pigeons, Columba livia, during the non-breeding season. Both PX and M, induced hypoglycemia and tissue-glycogen depletion. Whereas PX induced B cell degranulation and decreased hepatic phosphorylase and G-6-P'ase activity, M induced A cell degranulation and increased hepatic phosphorylase and G-6-P'ase activity. It is

concluded that both PX and M produce same effects on carbohydrate metabolism throughout the year. This season independent effect has been purported to be due to a season independent influence of pineal on pancreatic hormones.

CHAPTER VII

The effect of long photoperiod on testes, adrenal and thyroid has been studied in intact and PX feral pigeons towards the end of the quiescent phase. Exposure of pigeons to long photoperiod, in the month just prior to normally expected recrudescence hastened testicular activation and potentiated the normally occurring adrenal activation and thyroid inhibition. However, long photoperiod given two months prior to recrudescence did not show any changes in testes, while inhibition of thyroid and activation of adrenal were clearly evident. Similarly, PX birds exposed to long photoperiod either one month or two months prior to recrudescence failed to produce any changes in testes, adrenal or thyroid. The results suggest that though the HHT and HHA axes remain responsive to photic stimulation, the HHG axis appears refractory during the quiescent phase. It also appears that pinealectomy prevents testicular recrudescence atleast in the immediately ensuing breeding phase.

CHAPTER VIII

Influence of long photoperiod on carbohydrate metabolism in terms of blood glucose level, tissue glycogen contents and hepatic phosphorylase and G-6-P'ase has been assessed in intact and PX pigeons prior to the recrudescent phase. Pinealectomy induced tissue glycogen depletion and hypoglycemia and also decreased hepatic phosphorylase and G-6-P'ase activity. These changes of PX were not affected by long photoperiod given either one month or two months prior to recrudescence. Intact birds responded to long photoperiod by hastening the normally occurring depletion in tissue glycogen content and hyperglycemia during transition from quiescence to recrudescence. This effect of long photoperiod was however seen clearly only in the month prior to recrudescence and not earlier. From the results it is concluded that long photoperiod can hasten the normally occurring alteration in carbohydrate metabolism during testicular recrudescence and that, this influence is shown only towards the end of the quiescent phase as there appears to be some sort of refractoriness prior to that. It is also concluded that pinealectomy prevents these changes in carbohydrate metabolism.

CHAPTER IX

Photoperiod-adrenal interactions on testicular recrudescence and on thyroid and adrenal activity have been evaluated. Pigeons treated with either DXM or corticosterone (CORT) were exposed to normal light/dark (NLD) or LD 18:6 and the effects on testis, thyroid and adrenal studied. Long photoperiod hastened testicular activation together with adrenal activation and thyroid inhibition, changes characteristic of normal recrudescence. Both DXM and CORT treatments prevented these favourable changes under NLD and attenuated the same under LD 18:6.Though corticosterone increased adreno-cortical activity, and favoured testicular activation, thyroid activity was concurrently increased. It is presumed from the present study that DXM and coticosterone act on a common locus inducing hyperactivity of the HHT axis leading to a dampening effect on testicular activation. It is also surmised that a long photic schedule by exerting a stimulatory action on HHG axis can resist the inhibitory action of HHT axis on testicular recrudescence.

CHAPTER X

The possible influence of photoperiodism on carbohydrate metabolism has been evaluated in the feral pigeons. Both DXM and CORT treated pigeons were exposed to NLD or LD 18:6 photoperiodic schedules and their tissue glycogen contents, blood glucose and hepatic phosphorylase and G-6-P'ase

activity assayed. Both DXM and corticosterone treatment increased tissue glycogen content under both photic schedules. The plasma glucose level increased under LD 18:6 while, CORT treatment decreased and, DXM treatment increased further the glycemic level under both photic schedules. The activity of hepatic phosphorylase decreased in all experimental birds while that of G-6-P'ase increased. From the results it can be concluded that gonadal recrudescence induces depletion of tissue glycogen content and hyperglycemia which are potentiated by long photic schedule. Chronic adreno-cortical suppression or activation have differential effects on glycemic status probably through their action on glucoregulatory centre or by altering the mechanisms involved in glucose absorption, uptake and utilization.