SUMMARY

Chapter I

This chapter deals with the materials and methods employed in the present investigations.

Chapter II

Avian kidney is now well recognised as a gluconeogenic organ. Gluconeogenic capacity of avian kidney surpasses that of avian liver. This is mainly due to the fact that many iso-enzymic forms of enzymes involved in gluconeogenesis are highly active in kidney. Gluconeogenesis usually takes place when animals are under starvation stress or when the diet is poor in carbohydrate. Three species of birds with different dietary specializations were selected for the present investigation, to study the effect of diet on gluconeogenic activities in the kidney. Pigeon is a graminivorous bird and its diet is rich in carbohydrate. Swift is an insectivore and its diet is rich in protein and lipid, and sparrow is an omnivorous one and its diet is rich in all. Alkaline and acid phosphatases, and GOT and GPT were maximum in the kidney of swift and least in that of sparrow. Lipid and glycogen, the storage products, were maximum in the kidney of sparrow while these were least in stenophagus pigeon and [illegible] swift. It can be concluded that, kidney of swift which consumes a protein and lipid rich diet of insects, is adapted for high rate of gluconeogenesis.

Chapter III

Glucocorticoid plays a major role in maintaining blood glucose level and most of its actions are manifested due to the presence of specific receptor on the target tissue. Kidney has been known to be involved in energy metabolism especially gluconeogenesis. The gluconeogenesis is under the control of hormones such as corticosterone in most of the tissues. Although avian kidney differs from that of mammals in many respects, the metabolic activities in it are more or less similar. Effect of corticosterone administration on the various enzymes involved in the glucose metabolism was investigated in the kidney of pigeon. In response to corticosterone injection the glycogen content was found to decrease. Corticosterone administration also produced a hyperglycaemic response. Phosphatases (Alkaline and Acid Pases) did not show any appreciable change. G-6-Pase and Na^+-K^+-ATPase also did not show much variation. Phosphorylase and LDH on the other hand showed increased activity. Of the two transaminases (GOT and GPT) only GPT showed increased activity. Protein value also showed an increase. In conclusion it can be said that kidney gluconeogenesis in birds is partly under the control of corticosterone and the kidney could actively be involved in maintaining the high level of glucose in the bird by rapidly converting amino acids to glucose.

Chapter IV

Thyroid hormones are known to regulate metabolic rates of the body in general, and oxidative reactions in particular. Effect of thyroid hormones (thyroxine and triiodothyronine) was investigated in the kidney of pigeon. In response to T_4 administration both non-specific phosphatases did not show variations. On the other hand T_3 caused slight increase in Alk Pase but failed to cause any change in acid Pase. GOT did not respond to either T_4 or T_3 administration whereas GPT showed increased activity. Na^+-K^+-ATPase also did not show any change with T_4 and T_3 administration. Similarly G-6-Pase and AChE also did not show any variation. Phosphorylase and LDH both increased with T_4 as well as T_3 administration. T_4 and T_3 both showed hyperglycaemic action and glycogen content of the kidney showed depletion. It can be concluded that thyroid hormones have a partial role in the control of kidney's gluconeogenic activity.

Chapter V

Insulin has long been known to inhibit gluconeogenesis. Administration of insulin produced a hypoglycaemic condition with decreased glycogen content in the kidney of pigeon. Activities of acid and alkaline phosphatases along with both the transaminases (GOT and GPT) as well as AChE and LDH were decreased in response to insulin administration. On the other hand phosphorylase and G-6-Pase did not show any significant

variations. Protein value showed an increase. In the present work, insulin did not show any significant effect on the activities of glycogenolytic enzymes in the kidney. Thus it can be concluded that insulin exhibits an inhibitory influence on gluconeogenesis in the kidney of pigeon.

Chapter VI

ACh plays an important role in the regulation of blood sugar level by initiating the glucose uptake by liver cells. Vagal cholinergic fibres have some effect on kidney metabolism. In the present investigation ACh administration did not alter the glycaemic level as well as glycogen and protein contents. Of the two non-specific phosphatases, Alk Pase showed increased activity whereas acid Pase showed decreased activity. GOT showed decreased activity while GPT showed an increased activity. Na^{+}-K^{+}-ATPase and glycogen phosphorylase too showed decreased activites. G-6-Pase activity showed an increase in response to ACh administration. AChE and LDH were also decreased by ACh administration. Thus it can be seen that ACh administration brought about a general reduction in gluconeogenic activity in the kidney of pigeon.

Chapter VII

Glucagon treatment showed tremendous increase in glycaemic level and drastic reduction in the glycogen content

in the kidney. Alkaline and acid phosphatases showed decreased activities in the kidney of glucagon treated pigeons. Both the transaminases (GOT and GPT) too showed reduction in their activity. G-6-Pase did not show much variation. Na^+-K^+-ATPase, phosphorylase and LDH showed decreased activity. AChE did not show an increase in the activity. Protein content was also decreased. The data indicate that the major effect of glucagon on avian kidney metabolism was a general reduction in glycolytic activities.

Chapter VIII

Catecholamines are known to influence carbohydrate metabolism through α-adrenergic c-AMP independent, or through β-adrenergic c-AMP dependent mechanisms. Both these mechanisms activate protein kinases that phosphorylate enzymes involved in carbohydrate metabolism. In the present experiment E and NE produced hyperglycaemic responses and at the same time glycogen content showed an increase. Alk Pase showed an increased activity with NE administration and was decreased with E administration. Acid Pase was decreased by NE and increased by E administration. Phosphorylase showed decreased activity with both the catecholamines. G-6-Pase was decreased by E administration while NE did not produce variation in G-6-Pase activity. Na^+-K^+-ATPase and LDH showed increased activity with NE and it decreased with E. GOT increased with E and GPT did not show any change in the level of activity, whereas both the transaminases

did not show any variation with NE. E and NE increased the activity of AChE in the kidney and protein content showed reduction in both E and NE treated pigeons. Thus it can be said that E and NE have somewhat different actions on the gluconeogenic activity in the avian kidney. Secondly NE favours gluconeogenesis from lactate and E favours gluconeogenesis from precursors such as alanine and pyruvate and that catecholamines produced an increase in acetylcholine secretion.

Chapter IX

Autonomic nerves are found to have significant direct influence on metabolic activities, kidney metabolic activity can also be regulated by the autonomic nerves. In the present investigation 6-OHDA was administered which produced hyperglycaemia and at the same time kidney glycogen was also increased. Both the phosphatases showed a decrease by 6-OHDA administration. GOT increased while GPT was decreased in response to 6-OHDA treatment. Glycogen phosphorylase was decreased and Na^+-K^+-ATPase, LDH and G-6-Pase activities were increased. AChE activity too was increased with 6-OHDA treatment while protein content of the kidney did not show any variation. It was concluded that chemical sympathectomy produced no adverse affect on the metabolic activities of pigeon kidney, probably due to catecholamine present in the blood.

Chapter X

Vagal-cholinergic and sympathetic-adrenergic fibres are known to regulate activity of kidney by counter regulation. The present study deals with the histochemical changes in the kidney of vagotomized and chemically sympathectomized pigeons. Vagotomy and 6-OHDA treatment caused an increase in histochemical reactivity of alk Pase. The total lipid deposition was more in the cortical region than in medullary region in vagotomized pigeons whereas 6-OHDA treated pigeon kidney showed general reduction in total lipid. The neutral lipid deposition was increased in vagotomized pigeon whereas 6-OHDA treated pigeon showed general reduction in neutral lipids. Vagotomy caused a decrease in AChE activity, whereas 6-OHDA treatment produced an intensive reactivity of AChE in all the regions i.e. ICT, MC and cortical region of the lobule. These observations confirm that vagal impulses as well as sympathetic fibres do influence the functional aspect of kidney to a certain extent.