CHAPTER III

GLUCOSE TOLERANCE AND GLUCOSE CLEARANCE
INTRODUCTION

It is known that the blood sugar level in crustaceans is regulated by the neuroendocrine principles from the eyestalk and possibly from other neuroendocrine structures. Excess amounts of glucose injected extraneously into the crustaceans are rapidly cleared from the blood. Such rapid clearance of injected glucose is observed in several crustaceans such as crayfish (Riegel and Kirschner, 1960), lobsters, Panulirus sp. (Scheer and Scheer, 1951), Homarus sp. (Burger, 1957) and Jasus lalandii (Weber, 1971) and the crabs, Cancer magister (Meenakshi and Scheer, 1961; Holliday, 1978), Hemigrapsus nudus (Meenakshi and Scheer, 1961), Carcinus maenas (Binns, 1969), Scylla serrata (Deshmukh and Rangnekar, 1973) and Varuna kitterata (Madhyastha and Rangnekar, 1976).

Glucose injected beyond the tolerance limit causes glucosuria in several crustaceans (Burger, 1957; Riegel and Kirschner, 1960; Gross, 1967; Binns, 1969; Weber, 1971; Holliday, 1978). Apparent threshold haemolymph glucose levels for glucosuria are 150 mg% for Carcinus maenas (Binns, 1969) and 100 mg% for Cancer magister (Holliday, 1978), and for many crustaceans it ranges from 100-200 mg% (Riegel, 1972). Glucosuria in Cancer magister is overcome within a short time implicating no urinary loss of glucose (Holliday, 1978).

As the crustacean eyestalk hormones are implicated in the control of blood sugar level, attempts have also been made earlier to study the role played by these hormones in glucose tolerance and glucose clearance. Thus it was evident that glucose tolerance limits and the rate of glucose clearance from the blood are considerably altered through eyestalk
ablation in both *Scylla serrata* (Deshmukh and Rangneker, 1973) and *Varuna litterata* (Madhyastha and Rangneker, 1976). A recent study on *Cancer magister* showed that the extent of the glucosuria reached is related to the level to which the initial serum glucose level is raised by extraneous injection of glucose into the animals and also the glucose in the serum and urine are quickly cleared. Further it was shown that eyestalk ablation had no significant effect on either serum or urine glucose level or on glucose absorption from the bladder, thereby doubting the role played by the crustacean hormones on glucose tolerance and glucose clearance (Holliday, 1978).

In view of this, the glucose tolerance capacity and glucose clearance were studied in the crab, *Barytelphusa querini*. The role played by the hormones from the eyestalks and other central nervous structures in the glucose clearance was also investigated.

**MATERIALS AND METHODS**

The freshwater crab, *Barytelphusa querini* was used. Maintenance and preparation of animals for experimentation were as described earlier (vide Chapter II). Eyestalk ablation and preparation of the different extracts of neuroendocrine structures and quantity of extracts injected were all as described earlier (vide Chapter II). The sets of experiments conducted were as follows:

**I set:** Glucose solutions of three different concentrations (8%, 16% and 40%) were prepared by dissolving appropriate amounts of glucose (BDH 'AnalaR') in double distilled water.
A batch of 70 normal crabs with intact eyestalks were divided into 7 groups of 10 animals each (A, B, C, D, E, F and G). The blood was loaded with different amounts of glucose by injecting glucose solution of specific concentration and volume into each group of animals through the arthrodial membrane of the chelate leg with the help of a hypodermic syringe. 0.5 ml of 8%, 16% and 40% glucose solution were injected into the animals belonging to the groups A, B and C so that they received glucose at the rate of 1.2 and 5 mg/gm wet wt respectively. 1.0, 1.25, 1.50 and 2.0 ml of 40% glucose solution were injected into the animals of D, E, F and G groups so that they received glucose at the rate of 10, 12.5, 15.0 and 20 mg/gm wet wt respectively. Another set of animals received equal amounts of crab ringer (Venkatachari, 1979) and served as the controls for each group.

Mortality was noted in the different groups of control and experimental animals at different times and the difference between the two was taken to calculate the percent mortality of the crabs at various times after loading the blood with different concentrations of glucose. Mortality rate at 24 hrs and time taken for 50% mortality were also determined from the data obtained.

**II set:** The crabs were divided into 3 groups (A, B and C) and 0.5 ml of 8%, 16% and 40% glucose solution were injected into the animals belonging to these three groups so that they became loaded with glucose at the rate of 1.2 and 5 mg/gm wet wt respectively. The blood glucose level was estimated in these animals at different time intervals until the sugar content reached the original level.

**III set:** Blood was loaded with glucose at the rate of 1 mg/gm
wet wt by injecting 0.5 ml of 8% glucose solution into a batch of normal animals with intact eyestalks. Eyestalks were ablated from another batch of animals and glucose was injected, as in the normal animals, 24 hrs after eyestalk ablation. The blood sugar level was estimated at regular intervals in both the groups until the level reached the level at zero time.

IV set: A batch of animals whose eyestalks were ablated 24 hrs prior to experimentation were divided into 4 groups (A, B, C and D) and they were injected with extracts of eyestalks, sinus gland, brain and thoracic ganglionic mass respectively. They were loaded with glucose at the rate of 1 mg/gm wet wt by injecting 0.5 ml of 8% glucose solution, 24 hrs after injection of the extracts and the blood sugar levels were estimated at definite intervals until the values became steady. Blood sugar levels were also estimated in normal animals with intact eyestalks and in eyestalk-ablated animals (controls) for the purposes of comparison.

V set: Normal animals with intact eyestalks were divided into 6 groups (A, B, C, D, E and F). Extracts of eyestalks, sinus glands, brain and thoracic ganglionic mass were injected into the animals of the groups A, B, C and E respectively. Extracts of brain and thoracic ganglionic mass obtained from 20-days old eyestalk-ablated animals were injected into the animals of groups D and F respectively, 24 hrs after the injection of the extracts, they were loaded with glucose at the rate of 1 mg/gm wet wt by injecting 0.5 ml of 8% glucose solution and the blood sugar levels were estimated at definite intervals until they were steady. Normal blood sugar level
in intact animals was also estimated for comparison.

Blood sugar level was estimated by the Anthrone method (Roe, 1950). A minimum of six animals were used for obtaining the readings at each time interval. An analysis of glucose tolerance, glucose clearance and the role of different neuroendocrine structures in glucose tolerance and glucose clearance were made from the data obtained.

**RESULTS**

I. **Glucose tolerance**

There was no mortality in the crabs when they were injected with glucose at the rate of 1 mg/gm wet wt. Mortality was nil upto 36 hrs and only 10% mortality at 48 hrs was noted with injections at the rate of 2 mg/gm wet wt. The animals survived upto 24 hrs with glucose injection of 5 mg/gm wet wt and showed mortality of 10% and 30% at 36 hrs and 48 hrs respectively. Even at glucose injections of 10 mg/gm wet wt, a 10% mortality was noticed only after 24 hrs; however, by 48 hrs the mortality rose to 50%. Glucose injections at concentrations more than 10 mg/gm wet wt led to a high mortality even at 4 hrs period and high mortality rates of 70, 90 and 100% were recorded by 48 hrs on glucose loading of 12.5, 15.0 and 20.0 mg/gm wet wt respectively. It appeared that the animals easily tolerated glucose loading upto 10 mg/gm wet wt and high concentrations seemed intolerable leading to a higher percentage of mortality within a short time. Thus the glucose tolerance capacity of the crabs was dependent upon the extent of glucose loading and they could tolerate only smaller doses of glucose injected (Fig. 8).
Determination of 24 hr period mortality showed that there was no mortality up to 24 hrs when glucose was injected up to a dosage level of 5 mg/gm wet wt. A 10% of 24 hr mortality occurred at the glucose injection of 10 mg/gm wet wt and further increase in the proportion of glucose injected led to a significant and steep rise in the mortality (Fig. 9).

The time taken for 50% mortality was minimum when glucose was injected at the rate of 20 mg/gm wet wt and it increased with reduction in the extent of glucose loading. The time for taken for 50% mortality was as long as 108 hrs at glucose loading of 2 mg/gm wet wt and 50% mortality was not at all recorded at glucose loading of 1 mg/gm wet wt (Fig. 10).

II. Glucose clearance in relation to injected glucose concentrations:

Measurements of blood sugar level at different time intervals after glucose injection showed that the injected glucose was cleared from the blood with time. Maximum hyperglycemia was observed within 15 mins after the injection of glucose solution in the dosage of 1, 2 and 5 mg/gm wet wt. The level of maximum hyperglycemia attained increased with the dosage of glucose injected, the level being only 430 ± 30 mg sugars/100 ml for 1 mg/gm wet wt dosage and as much as 1840 ± 55 mg sugars/100 ml for dosage of 5 mg/gm wet wt. The blood sugar level declined with time in all the three cases. However, this decrease was much faster at lower dosage, while it was much slower at increased dosages. The sugar level returned to the normal in about 6 hrs for the dosage of 1 mg/gm wet wt, while restoration to normal level occurred in about 24 and 60 hrs for the dosages of 2 and 5 mg/gm
wet wt respectively. From the results it was evident that the hyperglycemic level attained and the time taken for clearance of injected glucose increased with extent of glucose loading (Fig. 11).

III. Effect of eyestalk ablation on glucose clearance:

In the case of the normal animals with intact eyestalks, the glucose injected led to maximum hyperglycemia within 15 mins (418.02 ± 30.39 mg sugars/100 ml). Glucose was cleared from the blood later and original level was restored in about 6 hrs (Fig. 12 A). In the case of the eyestalk-ablated animals also the injected glucose led to hyperglycemia within 15 mins but this hyperglycemic level was much less (328.47 ± 21.26 mg sugars/100 ml) compared to that in the normal animals and the difference was also significant (t = 5.60; P<0.01). Also the glucose clearance was much faster and the sugar level was brought back zero time value within 4 hrs (Fig. 12 B). Thus eyestalk ablation led to a greater glucose tolerance and a better and quicker glucose clearance.

IV. Effect of injection of extracts on glucose clearance in eyestalk-ablated animals:

Injection of eyestalk extracts into the ablated animals increased the blood sugar level to the normal level within 24 hrs, while injections of the extracts of sinus gland, brain and thoracic ganglionic mass did not elevate the blood sugar considerably and the hypoglycemic condition prevailed 24 hrs after the injections were made (vide Chapter II). Glucose tolerance showed different trends in these eyestalkless animals injected with different extracts 24 hrs prior to
glucose loading. In the eyestalk extract injected animals, maximum hyperglycemia was obtained within 15 mins and this hyperglycemic level was higher (533.56 ± 40.84 mg sugars/100 ml) compared to that obtained in the normal intact animals (418.02 ± 30.39 mg sugars/100 ml). Further, glucose clearance was less rapid and was completed by about 6 to 7 hrs as against the clearance time of 6 hrs in the normal animals and about 4 hrs in the eyestalk-ablated forms (Fig. 13 A). Even in the sinus gland extract injected animals, maximum hyperglycemia on injection of glucose was found within 15 mins but the hyperglycemic condition attained at this time was much lesser (357.88 ± 48.98 mg sugars/100 ml) compared to that in the normal animals (slightly more than that in the eyestalk-ablated animals. But the clearance was quite fast and achieved by about 4 hrs as in the eyestalk-ablated animals (Fig. 13 B). In both the brain and thoracic ganglionic mass extract injected animals also maximum hyperglycemic condition was attained within 15 mins (348.52 ± 46.13) and 335.85 ± 37.37 mg sugars/100 ml respectively) and this value was much lower compared to that in the normal animals. The glucose clearance was quite faster and content reached zero time level within about 4 hrs as in the eyestalk-ablated animals (Fig. 13 C,D). As such it was evident that the glucose clearance pattern in the eyestalk extract injected animals was much similar to that in the normal animals, while on injection of sinus gland, brain and thoracic ganglionic mass extracts, the clearance pattern did not change much and hence resembled that of eyestalk-ablated animals only.
V. Effect of injection of extracts on glucose clearance in normal animals:

On injection of eyestalk extracts into normal animals also the maximum hyperglycemic condition seen at 15 mins (600.50 ± 35.2 mg sugars/100 ml) but it was significantly higher (t = 6.57; P<0.01) compared that obtained in normal animals at the same time. Also the rate of glucose clearance was slow and it was cleared in about 8 hrs as compared to 6 hrs in the normal animals (Fig. 14 A). Even in the sinus gland injected animals the maximum hyperglycemia obtained at 15 mins was slightly higher than that in normal animals (500.20 ± 37.35 mg sugars/100 ml) but it was not much significant (t = 2.67; P>0.1). Glucose tolerance was rapid and the sugar level reached to zero time level in about 5 hrs, and this timing was intermediate between that obtained in normal and eyestalk-ablated animals (Fig. 14 B). On injection of both brain and thoracic ganglionic mass extracts maximum hyperglycemic values were obtained at 15 mins (400.30 ± 38.77 and 390.75 ± 50.32 mg sugars/100 ml respectively) and these values were comparable to that in normal animals. The glucose clearance was slow and the level reached the original by about 5 to 6 hrs as in the normal animals (Fig. 14 C, E). However, when extracts of brain and thoracic ganglionic mass from 20 days old eyestalk-ablated animals were injected, maximum hyperglycemic condition which was relatively lesser than that in the normal animals and more comparable to the eyestalk-ablated animals was obtained within 15 mins. However, glucose clearance was very fast and the sugar content reached the zero time level in about 3 hrs which
Legend for figures

Fig. 8: Percent mortality of the crabs determined at different timings after the injection of glucose solution of different concentrations.

= 1 mg/g wet wt = 2 mg/g wet wt
= 5 mg/g wet wt = 10 mg/g wet wt
=12.5 mg/g wet wt = 15 mg/g wet wt
=20 mg/g wet wt

Fig. 9: 24-hr period mortality rates in the crabs injected with different concentrations of glucose.

Fig. 10: Time taken for 50% mortality of the crabs on injection of different concentrations of glucose.

Fig. 11: Glucose clearance in the normal intact animals after injection of the different concentrations of glucose. The inset shows the time taken for glucose clearance as a function of the injected glucose concentration. Arrows indicate the time of glucose clearance.

A : 1 mg/g wet wt
B : 2 mg/g wet wt
C : 5 mg/g wet wt

Fig. 12: Glucose clearance in the normal intact animals (A) and on bilateral extirpation of eyestalks (B). Arrows indicate the time of clearance.

Fig. 13: Glucose clearance in eyestalk-ablated animals on injection of the extracts of eyestalks (A), sinus gland (B), brain (C) and thoracic ganglionic mass (D). Arrows indicate the time of glucose clearance.

Fig. 14: Glucose clearance in the normal animals on injection of extracts of eyestalks (A), sinus gland (B), brain (C) and thoracic ganglionic mass (E) from normal animals and extracts of brain (D) and thoracic ganglionic mass (F) extracts from 20-day old eyestalkless animals. Arrows indicate the time of glucose clearance.
was quite less even compared to that in eyestalk-ablated animals (Fig. 14 D,F).

Thus it was evident that injection of eyestalk extracts resulted in greater hyperglycemia and increased duration for glucose clearance. Injection of sinus gland, brain and thoracic ganglionic mass extracts caused only less hyperglycemia and clearance took about the same time as in normal animals. However, injection of brain and thoracic ganglionic mass extracts from 20 days old eyestalk-ablated animals caused significantly lesser hyperglycemic levels than those in the eyestalkless animals and also the glucose clearance took a shorter time when compared to that in eyestalkless animals.

DISCUSSION

Glucose forms an important constituent of the crustacean blood (Florkin, 1960; Hohnke and Scheer, 1971). The blood sugar level is maintained within the normal physiological range due to the significant role played by the glycemic principles released by the neuroendocrine structures (vide Chapter II).

Earlier investigations have shown that glucose injected extraneously into the crustaceans is rapidly cleared from the blood such that the blood sugar level is maintained within the normal range. However, glucose injected beyond the tolerance limits leads to glucosuria in several crustaceans (Burger, 1957; Riegel and Kirschner, 1960; Gross, 1967; Binns, 1969; Weber, 1971; Holliday, 1978). The threshold haemolymph glucose levels for glucosuria vary from 100 to 200 mg % in the different crustaceans (Riegel, 1972;
Holliday, 1978). The present investigation shows that the crab, *Barytelphusa querini* is able to tolerate extraneously injected glucose to a certain extent. Lower levels of glucose loading such as those obtained by injecting dosages of up to 5 mg/gm wet wt, are easily tolerated as mortality is nil even after 24 hrs of injection and the time taken for 50% mortality is relatively more. However, higher levels of glucose loading, obtained by injecting glucose at higher dosages of 10 to 20 mg/gm wet wt, are certainly intolerable and the animals show high mortality within 24 hrs and the time taken for 50% mortality is considerably reduced. It may be concluded from this that the crab, *Barytelphusa querini* can tolerate only limited glucose loading. High mortality with increased glucose loading might be due to severe hyperglycemia and the resulting glucosuria as evident in other crustaceans. The haemolymph glucose threshold for glucosuria in this crab might be higher as it is evident that injection of glucose at a dosage of 5 mg/gm wet wt would lead to an initial hyperglycemic condition of 1840 ± 55.00 mg sugars/100 ml of blood but still the mortality is considerably less and the crabs could exhibit good powers of glucose tolerance.

As a corollary to this glucose tolerance, it is also evident from the present study that maximum hyperglycemic level reached and the time taken for the glucose clearance are related to the dosage of the glucose administered. The hyperglycemic level reached at lower concentrations is less and the glucose could be cleared in short time, while with the increase in dosage, the hyperglycemia attained is high.
and the time taken for clearance also increases considerably. As the time taken for glucose clearance is shorter at a dosage of 1 mg/gm wet wt this dosage is considered ideal for further studies. This also permits comparison with earlier work as the earlier studies on other crustaceans were conducted with this dosage.

Our observations on the glucose clearance in Barytelphusa querini are in accordance with the findings reported in lobsters, Panulirus japonicus and Panulirus penicillatus (Scheer and Scheer, 1951) and the crabs, Scylla serrata (Deshmukh and Rangneker, 1973) and Varuna litterata (Madhyastha and Rangneker, 1976). In Panulirus sp. 80-90% of injected glucose was removed within the first hour of injection and the rest disappeared more slowly and took about 6 hrs more for the complete recovery to the normal level (Scheer and Scheer, 1951). In both Scylla serrata (Rangneker and Deshmukh, 1973) and Varuna litterata (Madhyastha and Rangneker, 1976) maximum hyperglycemic peaks were observed 15 mins after glucose injection and level returned to the normal within a short time. Even in the present investigation the peak hyperglycemic condition occurred within 15 mins from the time of glucose loading and a gradual decline and restoration to the normal level was noticed at all dosages of glucose injected. However, glucose clearance was not as rapid as reported for Panulirus sp. (Scheer and Scheer, 1951), since the glucose clearance rate, though rapid to start with, was slowed down during later periods of restoration. Similar observations were made in Scylla serrata (Rangneker and
Deshmukh, 1973) and *Varuna litterata* (Madhyastha and Rangnekar, 1976) also. Further it was observed in the present study that the rate of disappearance decreased with dosages and glucose clearance took relatively longer time. It is of interest to note that in the case of *Cancer magister* hyperglycemic peak obtained increased with the dosage but glucose clearance took about the same time i.e., 13.5 hrs irrespective of the dosage of injected glucose (Holliday, 1978).

No traces of glucose could be detected in the surrounding medium after glucose loading to different levels in all the experimental animals suggesting that excess glucose is not excreted. Glucosuria occurs in several crustaceans only when the blood glucose level increases beyond the threshold point. Moreover, it is shown in *Cancer magister* that only relatively small amounts of glucose appear in urine and urinary glucose loss is only a negligible factor in lowering of serum glucose levels (Holliday, 1978). As the urinary bladder has the capacity to absorb large amounts of glucose from urine through the active transport mechanism (Riegel, 1972) glucosuria cannot be considered a possible reason for the glucose clearance.

That the excess glucose injected is rapidly oxidised is also not possible since if all this glucose is to be oxidised the rate of combustion will have to increase many times over the usual rate at room temperature and such an increase in the rate of combustion can not occur for reasons best known and as shown in crayfish (Nemmingson, 1924). Further, the metabolic rate has got to increase enormously to meet the requirements of oxygen demands. The disappearance
of glucose from the blood may hence be attributed to its mobilisation from the blood to other structures for deposition as glycogen or some other form of storage.

It is shown in *Cancer magister* that the glucose rapidly taken up by the bladder is not transported across the tissue to any significant extent and transportation from urine to haemolymph takes place in the form of a metabolite but not as free glucose (Holliday, 1978). Meenakshi and Scheer (1961) found greater concentration of g1-6-P0₄ than glucose (7.2 and 5.7 mg% respectively) in the haemolymph of *Cancer magister*. Further, radioactive label from injected glucose appeared rapidly in haemolymph g1-6-P0₄ and more slowly in maltose oligosaccharides. Maginniss (1976) reported that trititated glucose is taken up by the midgut gland of the prawn, *Macrobachium rosenbergii*, and that the label was accumulated by the tissue in the form of hexose phosphate, while only a small fraction of the accumulated label was in free glucose. The observations made after the injection of C¹⁴ glucose into spiny lobster (Scheer and Scheer, 1951) suggested that the primary importance of glucose is in relation to the formation of chitin of the integument and glycogen of the hepatopancreas. There is also good evidence available to show that the excess blood sugars are utilised for the synthesis of glycogen and other polysaccharide materials (vide Chapter II). Glucose clearance from the blood may, then, be due to its conversion to other metabolites and its transportation to other avenues for its conversion to glycogen etc.

The glucose tolerance tests carried out in the normal
and eyestalkless animals and also after injection of different extracts into normal and eyestalk-ablated animals throw some light on blood sugar homeostasis and the neuroendocrine control of glucose clearance. It was evident that though the hyperglycemic peak occurred 15 mins after glucose administration in all the cases, the extent of hyperglycemic level and the time taken for glucose clearance was different in different conditions. The hyperglycemic condition attained in eyestalk-ablated animals is lesser than that in the normal animals and also the time taken for glucose clearance decreases by 2 hrs. As such it may be assumed that bilateral eyestalk extirpation results in considerable increase in the rate of removal of injected glucose and thus increases the tolerance of injected glucose. Similar observations are made in Varuna litterata (Madhyastha and Rangneker, 1976) and even in Scylla serrata where eyestalk ablation actually leads to hyperglycemic condition originally (Deshmukh and Rangneker, 1973).

Differences in the hyperglycemic level and the glucose clearance time can be explained in view of the role played by the neuroendocrine principles regulating the blood sugar level and carbohydrate metabolism. The hyperglycemic factor present in the eyestalk keeps the blood sugar level normally at elevated level. Further UDPG-GT inhibitor, presumably present in the eyestalks as in other crustaceans (Wang and Scheer, 1962; 1963; Ramamurthi et al., 1968), inhibits glycogen synthesis, thus preventing mobilisation of blood sugar to sites of glycogen synthesis. The hyperglycemic factor itself may be concerned with activation of
phosphorylase enzyme, as in other crustaceans (Keller, 1965b; 1966, Bauchau et al., 1968; Ramamurthi et al., 1968) and facilitate glycogen breakdown. High glycemic levels and delay observed in removal of injected glucose in the normal animals may be due to the continued effect of operation of glycogenolysis and prevention of glycogenesis. Conversely, low glycemic level in eyestalk-ablated animals may be one reason for low peak of hyperglycemic level obtained on glucose administration. Besides, eyestalk removal leads to deprivation of hyperglycemic factor and also UDPG-GT inhibition due to which glycogenolysis is prevented and glycogen synthesis increases. Thus lower level of hyperglycemic peak and faster glucose clearance in eyestalkless animals may be attributed to increased rate of glycogen synthesis and prevention of glycogen breakdown. Thus the differences in hyperglycemic peaks and glucose clearance times between normal and eyestalk-ablated animals can be due to the presence or absence of the hyperglycemic factor and UDPG-GT inhibitor in the blood stream.

Studies on glucose clearance in normal and eyestalk ablated animals after injection of the different extracts offer confirmatory evidence for the above view regarding the role played by the neuroendocrine principles in controlling the glycemic level and bringing about glucose clearance.

Elevation of hyperglycemic level beyond the normal condition and further increase in the glucose clearance time observed in the normal animals on injection of eyestalk extract can, therefore, be due to the additional titres of hyperglycemic principle and UDPG-GT inhibitor introduced
into the blood through eyestalk injection. Similarly, restoration of the hyperglycemic level and glucose clearance time to that of the normal animals on injection of eyestalk extracts into ablated animals may be due to the restoration of the concentration of the hyperglycemic factor and UDPG-GT inhibitor to the normal level by the injection of extracts. As the sinus gland is only the storage and release centre its injection into both normal and eyestalk ablated animals produce only intermediate results. As the brain and the thoracic ganglionic mass do not obviously possess these factors, injection of their extracts into both the normal and eyestalk-ablated animals do not significantly alter the hyperglycemic level and glucose clearance time.

It may be mentioned that a similar mechanism is proposed to explain the differences observed in relation to the hyperglycemic level and glucose clearance times in *Scylla serrata* (Deshmukh and Rangneker, 1973) and *Varuna litterata* (Madhyastha and Rangneker, 1976). Further it is reported in *Scylla serrata* that both hyper and hypoglycemic factors are present in the eyestalk and the hypoglycemic factor exerts its influence on the eyestalk-ablated forms only. As such, on injection of eyestalk extracts into eyestalk-ablated animals, the hypoglycemic factor shows more pronounced activity and hyperglycemic factor produced in extra-eyestalk structures may not be powerful. The rapid glucose clearance and lower peak of hyperglycemic level in the eyestalk-ablated animals compared to the normals are hence assumed to be due to the activity of this hypoglycemic factor (Deshmukh and Rangneker, 1973).
Even in *Barytelphusa querini*, a hypoglycemic factor is suggested to be present in the central nervous structures but its effect is negligible under normal conditions and it becomes more pronouncedly active only on 20-days of eyestalk ablation. That the hyperglycemic peak and glucose clearance time are not effectively altered on injection of the central nervous extracts into the normal and eyestalk ablated animals also suggests the same. Further the fact that injection of brain and thoracic ganglionic mass extracts from 20-day old ablated animals into normal animals decreases the hyperglycemic peak and glucose clearance time supports the assumption that the hypoglycemic factor, available in these structures, becomes pronouncedly active only on long term eyestalk ablation.

**SUMMARY**

1. Investigations on glucose tolerance, glucose clearance and the neuroendocrine control of glucose clearance are made in the crab, *Barytelphusa querini*.

2. Administration of glucose in different dosages shows that the crabs, have only limited glucose tolerance capacity and higher dosages (10 mg/gm wet wt and above) lead to increased mortality in a shorter time.

3. A hyperglycemic condition is seen within 15 mins after glucose administration and the injected glucose is cleared from the blood with time. The peak hyperglycemic level attained and the time taken for glucose clearance increase with the dosage of injected glucose.

4. The peak hyperglycemic level and the glucose clearance
time are lesser in the eyestalk-ablated animals that in the animals with intact eyestalks suggesting that the eyestalk ablation facilitates increased glucose tolerance and rapid glucose clearance.

5. Injection of eyestalk extracts into eyestalk-ablated animals increases the peak of hyperglycemic level and glucose clearance time to those of the normal animals. The effect of sinus gland injection is intermediate while brain and thoracic ganglionic mass extracts do not considerably alter the hyperglycemic level and glucose clearance time of the eyestalk-ablated animals.

6. Injection of eyestalk extracts into normal animals increases the hyperglycemic level and glucose clearance time beyond that of normal animals. Injection of sinus gland extracts raises the two only slightly while injection of brain and thoracic ganglionic mass extracts do not change the two parameters appreciably. However, brain and thoracic ganglionic mass extracts from 20-days old eyestalk-ablated animals decrease the hyperglycemic level and glucose clearance time considerably.

7. It is suggested that the glucose tolerance and glucose clearance are under the neuroendocrine control and the possible basis for such a control is indicated in the light of the available data on other crustaceans.