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CHANGES OF GLUCOSE AND GLYCOGEN CONTENT IN THE MATERNAL AND EMBRYONIC TISSUES OF THE VIVIPAROUS SCORPION *HETEROMETRUS FULVIPES* DURING GESTATION PERIOD

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ABSTRACT

Changes in the glucose and glycogen content of the maternal and embryonic tissues of the viviparous scorpion *Heterometrus fulvipes* have been followed during the gestation period.

The glycogen content of the hepatopancreas of the maternal animal gradually increases upto the sixth stage followed by a steady decline until parturition. The glucose content broadly follows an inverse course.

The glucose level of maternal haemolymph shows a peak in the third stage followed by a gradual decline upto the sixth stage. A second peak appears at the seventh stage followed once again by a decline.

The glucose content of the developing embryo remains low all through the embryogenesis. The glycogen content of the whole embryo shows a steep rise only from the sixth stage onwards indicating embryonic synthesis from that stage.

It is inferred that the energy requirements of the embryo are met by maternal supply of carbohydrates upto the sixth stage and beyond the sixth stage of development the embryo might utilize the reserve stores and/or the maternal supply.

INTRODUCTION

AMONG arachnids the scorpions have adopted viviparity and the developing embryos are provided with nutrients secreted and channelled to the embryo by the appendix[1,2]. Studies on the biochemical changes in the materal animal and in the embryo during gestation period are mostly confined to mammals[3], fishes[4] and insects[5–8]. Investigations have, therefore, been undertaken to study the biochemical changes in the maternal animal and in the embryo during the gestation period of the viviparous scorpion, *Heterometrus fulvipes* and the present paper deals with changes in glucose and glycogen contents. *H. fulvipes* shows a difinite breeding season confined to July and August and a gestation period of about 11 months[9]. For purpose of the present study, the embryonic stages from gastrula stage upto the time of parturition were divided into 8 stages based on the approximate age and certain morphological features of the embryo.

MATERIALS AND METHODS

Scorpions collected from near the foot of Tirumala hills were brought to the laboratory and kept in suitable vivaria containing moist sand. Cockroaches were provided as food and the scorpions were free to feed *ad lib*.

Females at appropriate stages of the gestation period were taken and haemolymph was drawn using a hypodermic syringe for estimation of glucose content. Hepatopancreas and follicles (exclusive of appendix) containing the embryos were removed for the assay of glucose and glycogen after dissecting the animal from which the haemolymph has been drawn.

Glucose and glycogen contents of hepatopancreas and embryos were determined using the method of Kemp and Kits[10]. For determination of haemolymph glucose Folin Malmros (Folin) microprocedure as modified by Murrel and Nace[11] was followed.

RESULTS

Glucose and Glycogen Content of the Hepatopancreas of the Maternal Animal

The glycogen content of the hepatopancreas of the maternal animal shows a steady and gradual increase upto the 6th stage of embryonic development and this is followed by a steady and continuous decline upto parturition and for about a week after parturition (Fig. 1).

Though a significant increase of glucose content of the hepatopancreas of the maternal animal is noticed upto the 3rd stage of embryonic development, further changes beyond 3rd stage follow a near reciporcal relationship with the glycogen content (Fig. 1).

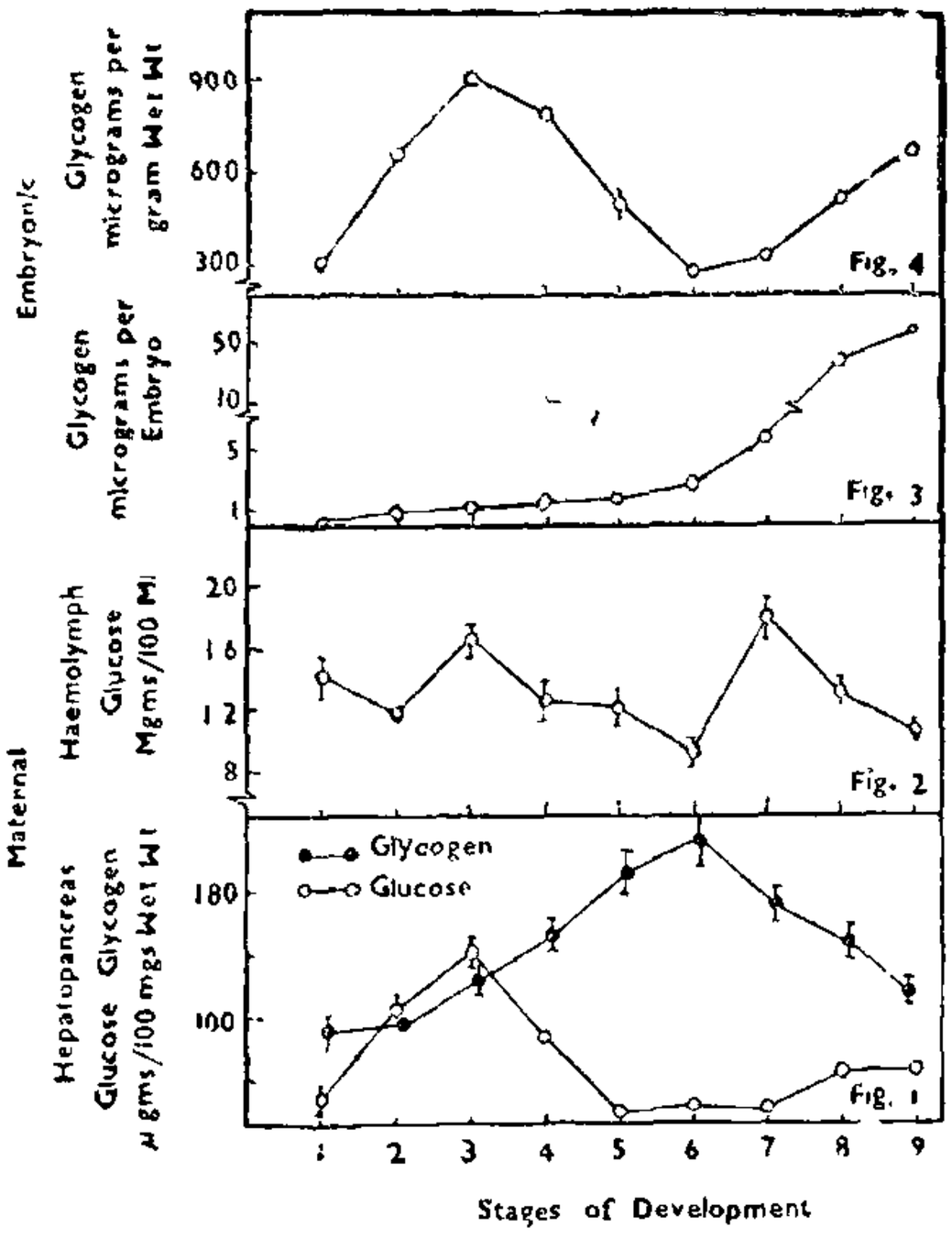
Changes in the Glucose Content in the Haemolymph of the Maternal Animal

Figure 2 reveals that the fluctuation is marked by two significant peaks, one at the 3rd stage and the other at the 7th stage, which are followed by gradual decline in the glucose content.

Glycogen Content of the Embryos

The glycogen content of the whole embryo shows a gradual and continuous increase through successive stages of embryonic development with a remarkable increase beyond the 6th stage.. Increase in the glycogen

content of the whole embryo continues right upto the time of parturition (Fig. 3.).



FIGS. 1–4, Glucose and glycogen content in the maternal tissues and glycogen content of the embryos at different stages of development during the gestation period of the viviparous scorpion *Heterometrus fulvipes*.

The stages of development correspond to the age (in months) given in paranthesis. 1 (1); 2 (2); 3 (3); 4 (5); 5 (7); 6 (8); 7 (9); 8 (10–11); 9 (one week after parturition).

However, the glycogen content/gram wet wt. of the embryonic tissues shows an increase only upto 3rd stage followed by a gradual decline upto 6th stage, from which time onwards a significantly increasing trend continues upto the time of parturition (Fig. 4).

DISCUSSION

The increase in the glucose content of haemolymph and the hepatopancreas and the increase in the glycogen content of the hepatopancreas of the maternal animal and the embryos upto the third state suggest a remarkably active physiological state of the maternal animal marked by synthetic activity. This synthesis in the earlier period of gestation is possibly a preparatory for successful promotion of embryonic development.

The reciprocal changes in glucose and glycogen content of the hepatopancreas in the maternal animal from 3rd stage onwards suggest an active incorporation of glucose into glycogen upto the 6th statge. Such inverse relationship also exists between the haemolymph glucose content and the glycogen content of hepatopancreas of the maternal animal from stage 3rd to 6th stage. This further reinforces the suggestion of active incorporation of glucose into the reserve material, the glycogen. The decilne in glycogen content of the hepatopancreas of maternal animals from 6th stage onwards upto the time of parturition suggests a drain and utilization of reserve glycogen both for maternal maintenance and embryonic development, as in the insect *Leucophaea maderae*[5]. The higher glucose level of the haemolymph beyond 6th stage is perhaps correlated with the utilization and transport of stored glycogen.

Though there is a continuous increase in the glycogen content of the whole embryo upto the time of parturition as in chick, rabbit, pig, cow and sheep[12], the results expressed as glycogen content per gram wet weight reveal an actual decline from stage 3rd upto stage 6th, suggesting that the accumulation of glycogen in the embryonic tissues does not keep pace with the growth of the embryo during these stages. The increase in the glycogen content per gram wet weight of the embryonic tissues from 6th stage onwards is suggestive of augmented synthetic potentialities of embryonic tissues. The hepatopancreas has been shown to be the site of synthesis of glycogen in the scorpion *H. fulvipes*[13]. Mathew[2] working on the embryology of the scorpion *H. scaber* has shown that the hepatopancreas appears in the embryos at a stage when the embryo is 6 to 6·5 mm. This stage nearly corresponds to the 6th stage of *H. fulvipes*. Appearance of hepatopancreas at this stage was noted in *H. fulvipes* also (personal observation). In the light of these facts, the actual synthesis and storage of glycogen within the embryonic tissues appear to be correlated with the development of hepatopancreas. From 6th stage onwards it could be stated that the embryo relies either on its own reserves or the maternal sources for its carbohydrate requirements. Till this stage the carbohydrate requirements of the embryo are probably met by the maternal animal.

The increase in glycogen contents during the first three stages may not mean any synthetic ability of the embryo. The increase might only imply deposition of the storage material in the follicular tissue (from maternal sources) which constitutes a significant proportion of the weight, when the entire follicle is taken to represent the embryo.

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INDIAN NATIONAL SCIENCE ACADEMY, NEW DELHI

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The Indian National Science Academy instituted in 1974 Science Academy Medals for Young Scientists to give recognition to the scientific achievements of scientists below the age of 30, in any branch of science and technology within the purview of the Academy.

The Council of the Indian National Science Academy has selected 11 scientists for the award for the year 1978. The presentation will be made at the time of the Annual General Meeting of the Academy, during the 66th Session of the Indian Science Congress to be held in January 1978.

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