are an additional indication of functional preparedness for accepting the conceptus. Therefore, factors other than stated above such as suckling young clinging to the mother's body, etc., may be responsible for reducing the attractiveness of the female, so that her chances of successful mating are reduced.

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CHANGES IN THE OXYGEN CONSUMPTION OF THE MATERNAL ANIMAL, AND MATERNAL AND EMBRYONIC TISSUES DURING THE GESTATION PERIOD OF THE VIVIPAROUS SCORPION, *HETEROMETRUS FULVIPES*

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ABSTRACT

The respiratory metabolism of the maternal animal, and maternal and embryonic tissues of *Heterometrus fulvipes* is studied at different stages of development. The embryonic metabolism is almost similar to the maternal metabolism. From the metabolic compatibility observed between the embryo and the maternal animal, it is suggested that the development proceeds without any obligatory sacrifice on the part of the mother.

INTRODUCTION

THE pattern of respiratory metabolism during gestation period is known only for mammals[1]. It is desirable to extend similar studies to other animals, invertebrates in particular, where viviparity exists, for understanding the metabolic relationships between the maternal animal and the growing embryos during gestation period. *Heterometrus fulvipes* is a viviparous scorpion with a long gestation period of about 11 months[2]. An attempt is made here to study the respiratory metabolism of the maternal animal and maternal and embryonic tissues at eight different stages of development of *H. fulvipes*.

MATERIALS AND METHODS

Scorpions were collected and maintained as reported by Subburam and Reddy[3]. Hepatopancreas, muscle and the embryos were obtained from gravid females at appropriate stages of the gestation period as reported

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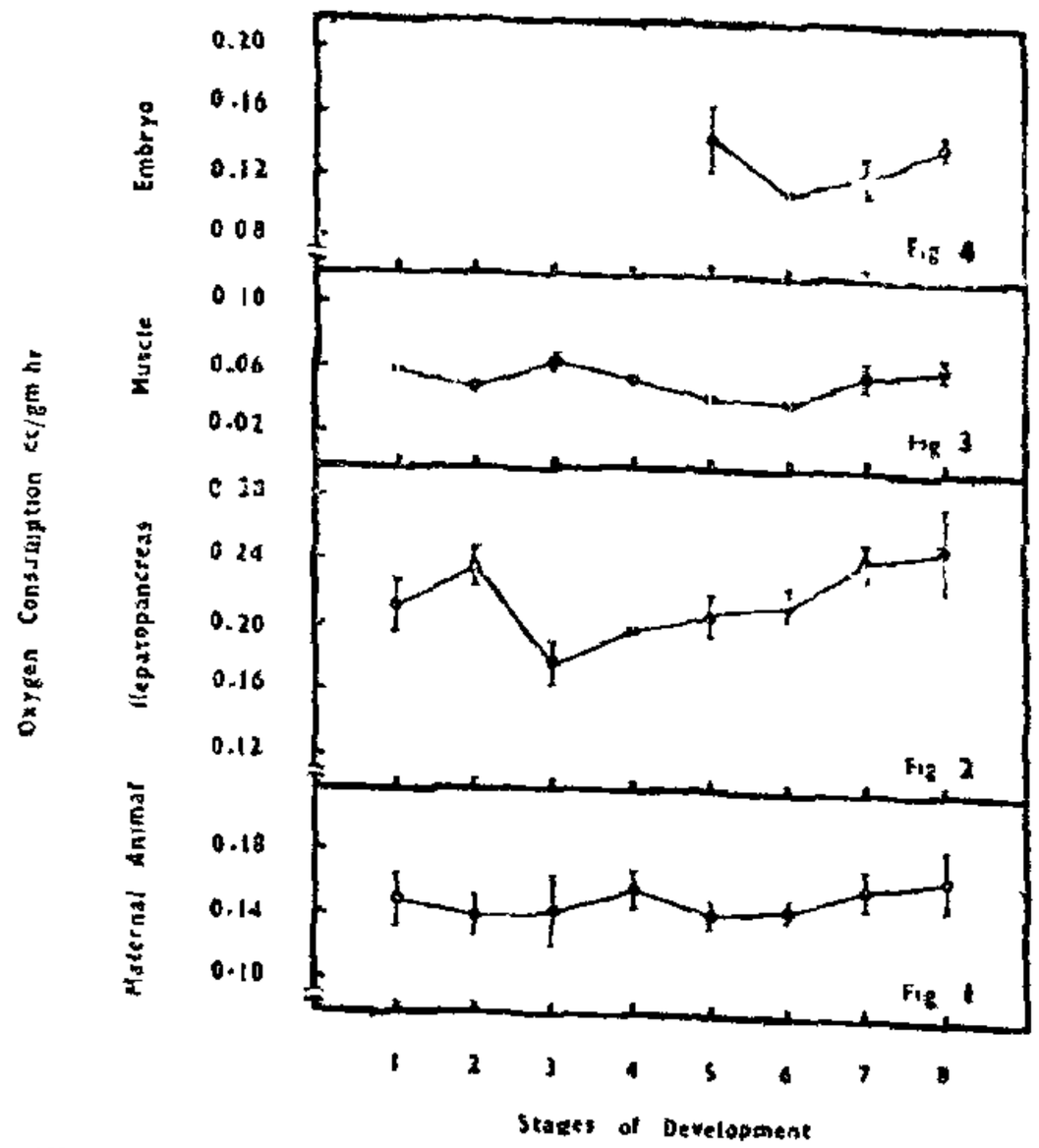
earlier[8]. Oxygen uptake by the minced preparations of the hepatopancreas, pedipalpal muscle and the whole embryos were measured with the Warburg's apparatus using conventional techniques. For measuring the oxygen consumption of the maternal animal during the different stages of development, the Warburg flasks were replaced by larger glass flasks of about 250 ml capacity for accommodating the animal and for providing sufficient gas phase for the animal to respire during experimental period. The carbon dioxide absorbent (5 ml of 20% KOH solution) was suspended in the flask with fluted filter-paper inserted into the container. For every experiment, one hour was allowed for equilibration before the apparatus was set to work. The temperature of the bath was 30 ± 1° C. In view of the fact that there is a marked diurnal variation in the oxygen consumption of *H. fulvipes*[4] all the measurements were made between 8 A.M. and 10 A.M. The amount of oxygen consumed was calculated as described in Manometric techniques by Umbreit *et al.*[5].



FIGS. 1–4. Oxygen uptake by the maternal anima and maternal and embryonic tissues at different stages of development 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).

RESULTS AND DISCUSSION

The oxygen consumption of the maternal animal measured at different stages of embryonic development during the gestation period reveals no statistically significant differences (Fig. 1).

The tissue respiration measured for hepatopancreas of the maternal animal reveals that it is metabolically most active, showing a gradual increase from the third stage onwards upto the eighth, the higher metabolic rate during the eighth stage being statistically significant from that of the third ($P < 0{\cdot}01$) (Fig. 2).

The muscle metabolism of the maternal animal shows a low level of activity with no definite trends correlated with the embryonic development (Fig. 3).

The oxygen consumption by the embryonic tissues measured only from the fifth to eighth stages, reveals a significant increase between the sixth and eighth ($P < 0{\cdot}01$) (Fig. 4).

In the insect, *Glossina*, the oxygen consumption of the pregnant female was shown to increase remarkably two days before larviposition[6]. The respiratory metabolism of mammals is known to increase with the advancement of pregnancy[1]. No such increase is noticed in the scorpion, *H. fulvipes*.

The increase in the oxygen consumption of the maternal hepatopancreas as the pregnancy advances is, however, an indication of enhanced energy exchange and involvement of the tissue in meeting the energy demands and nutritive requirements of both the mother and the embryo as the development proceeds.

A comparison of the metabolic rates of the maternal animal with the tissue respiration of the embryos during corresponding stages shows no great differences. When compared with the maternal hepatopancreas the embryonic tissue respire at a lower rate, whereas, when compared with the metabolically less active tissue, the muscle, their rate of metabolism is greater. However, if the sum of the mean of the values obtained for the two predominant tissues, *viz.*, muscle and hepatopancreas is compared with the respiration of the embryonic tissues, the embryonic metabolism is not greater. Such a situation suggests that the growing embryo of *H. fulvipes* behaves more as a mere addition to the size of the maternal animal than as a tissue metabolically more active. The absence of higher rate of metabolism in the developing embryonic tissues may be considered an adaptive feature on the phase of the long duration of the gestation period and an anticipated uncertain availability of sufficient food to the gravid female all through the period of pregnancy. If the metabolic rate of the embryonic tissues were to be enormously high compared to the maternal tissue the economical relationship between the mother and the foetus would be upset and the foetus might have to draw nourishment from the mother as a parasite. The metabolic compatibility of the whole animal and the embryo might be taken to suggest that the development proceeds without any obligatory sacrifice on the part of the mother.

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