of a series of paired varieties[10]. No statistical significance has been attached to differences with a probability value $p > 0.05$.

*Results.* The results are summarized in the table. Hepatoma cells exhibit higher levels of leucine incorporation into protein in comparison to liver slices ($p < 0.01$), while there are no significant differences between livers of male and female rats. $7.38 \times 10^{-4}$ M octanoate does not significantly modify leucine incorporation into protein of liver slices of rats of both sexes, while in hepatoma cells a 19% inhibition has been observed. $3.69 \times 10^{-3}$ M octanoate depresses protein synthesis about to the same extent in male (71%), female (74%) and hepatoma cells (76%).

*Discussion.* The higher levels of leucine incorporation into protein of hepatoma cells, in comparison with liver slices, is in line with previous results[8]. The greater susceptibility of protein synthesis of hepatoma cells to the lower concentration of octanoate could reflect a greater general sensitivity of tumors to exogenous FFA, since a defective feedback control of fatty acid synthesis has been demonstrated in hepatomas[11]. However, the different response could be also due to differences in the experimental models, i.e. isolated cells and slices.

It seems possible that the inhibition of protein synthesis by octanoate could be connected with that of glycolysis[3-5] and of mitochondrial respiration[12] previously found. The effect of octanoate on glycolysis has been obtained by preincubation with a cell-free supernatant fraction and, therefore, a direct extrapolation cannot necessarily be made with the results here reported. However it appears interesting to remember that a stimulatory effect by FFA on gluconeogenesis has been noted for tissue slices[13], perfused liver[14] and whole animal[15], and that this action has been connected to the inhibition of glycolysis[5]. The depression by octanoate of oxidation by rat liver mitochondria has been noted with much higher concentrations[12] than those used for the present experiments. However, it has been observed that a direct extrapolation cannot necessarily be made under the various experimental conditions. Namely the degree of micelle formation and protein binding is likely to differ for fatty acids on addition to cell-free systems, in the cell and in the whole organism[5].


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## Effect of the scorpion, *Heterometrus fulvipes* (C. Koch), venom on some enzyme systems in rat (albino) tissues


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*Summary.* Sublethal doses of *Heterometrus fulvipes* venom decreased NADP-specific isocitrate dehydrogenase and malate dehydrogenase activity levels and increased NADP-specific glucose-6-phosphate dehydrogenase and alkaline phosphatase activity levels during a 48-h-period.


The scorpion venom produced respiratory and cardiovascular arhythmia by its effect on cholinergic and adrenergic systems[2] Venom also caused alterations in NAD-specific dehydrogenases and hydrolytic enzyme systems both in vivo and in vitro conditions[3,4]. *Leiurus quinquestriatus* venom was known to produce linear inhibition of catalase activity in human erythrocytes[5], while *Buthus minax* venom inhibited acetylcholinesterase and succinate dehydrogenase activities in mouse tissues[6]. Hyperglycemic response due to venom action were also reported[7]. The present study reports changes in certain enzyme activities of metabolic significance due to sublethal doses of a less virulent type of the South Indian scorpion venon (*Heterometrus fulvipes*) in brain, sartorius and heart muscles, liver and serum of albino rats.

*Materials and methods.* Scorpion venom was collected by electrical stimulation. Crude and freshly collected venom was used. Protein content[8] was taken as criterion to express venom quantity. Male albino rats weighing 250 g were allowed free access to food and water, and $LD_{50}$ was determined by the method of Reed and Muenchi[9]. $^1/_3 LD_{50}$ was taken as sublethal dose. The animals were sacrificed after 6, 12, 24, 36 and 48-h-periods, and the tissue viz., brain, sartorius muscle, heart muscle and liver were quickly isolated at ice-cold temperature and homo-


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genates prepared in 0.25 M ice-cold sucrose. Normal animals which received same amount of saline instead of venom served as controls. Blood was collected and serum separated. NADP-specific isocitrate dehydrogenase[10], malate dehydrogenase[11], glucose-6-phosphate dehydrogenase[12] and alkaline phosphatase[13] activities were assayed with slight modifications in normal and experimental tissues. Statistical calculations were made according to the method of Pillai and Sinha[14].

*Results and discussion.* Sublethal dose of *H. fulvipes* venom produced a significant decrease in NADP specific dehydrogenases, viz., isocitrate dehydrogenase and malic dehydrogenase activity levels in brain, sartorious and heart muscles and liver tissues of albino rats (figures 1 and 2). During a period of 48 h, maximum decrease of the 2 enzyme activity levels was around 24 h (Isocitrate DH: 92% heart, 81% brain, 67% liver and 47% muscle; MDH: 75% heart, 69% brain, 62% liver and 34% muscle) From then onwards the activity levels tended towards normal values and the percentage change at 48 h was not significant. The decrease in activity levels of NADP-specific Kreb's cycle enzymes indicates a decreased oxidative state of the cells after venom poisoning. Inhibition of succinate dehydrogenase and acetylcholinesterase activity levels were reported due to *B. minax* venom in rat tissues[5] and due to *H. fulvipes* venom in frog brain, muscle and liver[4]. It was also reported that *T. serrulatus* produced respiratory and cardiovascular arhythmia[2] causing anoxic condition[15]. *H. fulvipes* venom in sublethal doses decreased oxygen consumption[16]. Hence it may be suggested that even in sublethal doses the venom decreased aerobic oxidation. NADP-specific G-6-PDH, which operates at the critical cross-roads of Embden-Meyerhof and pentose phosphate pathways (PPP), increased significantly after venom administration (figure 1). Maximum increase (99% liver, 75% sartorius muscle, 58% heart and 52% brain) was around 24 h after envenomation. Then onwards the activity level of the enzyme gradually reached almost the normal level by 48 h. The increased PPP may also contribute its pentoses to the synthesis of RNA and to promote protein synthesis. Hence it is likely that glucose is mobilized via PPP after venom poisoning while Kreb's cycle is less operative. Further, the different oxidoreduction systems share a common pool of NAD(P)/NAD(P)H ratio, the alterations of which may disturb the normal energy charge of the cell[17]. Hence it is likely that decreased Kreb's cycle enzyme activity levels and increased glycolytic enzyme activity levels may also alter the normal NAD(P)/NAD(P)H ratio, thereby altering energy metabolism of the animal. Further it is reported that LDH-activity increased, SDH-activity decreased and the lactic acid level increased in liver[4], suggesting prevalence of anaerobic condition in the cellular environment after *H. fulvipes* envenomation.

Alkaline phosphatase (ALP) activity, which splits the glycerophosphate ester, increased enormously after *H. fulvipes* envenomation (figure 2). The increase was more in serum, liver and heart. However, the increase was insignificant in brain. The maximal increase in activity level of ALP also occurred at 24-h-period (100% in serum, 92% liver, 69% heart, 32% muscle and 9% brain). From then onwards, it tended towards normal level and at 48 h the change in activity level was negligible in brain, heart muscle and sartorius muscle. An increase of 38% in liver and 42% in serum still remains even after 48 h. It is known that serum ALP activity level increases during pathological conditions of liver due to biliary obstruction[18]. Large amounts of enzyme leaks out from the parenchymal cells of liver. *H. fulvipes* venom sublethal doses also caused hypercholesterolemia due to biliary obstruction (communicated). These results suggest altered liver metabolism after venom poisoning.

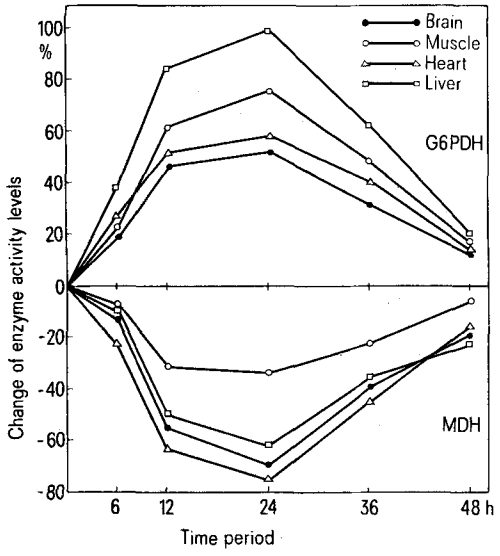


Fig. 1. G6PDH, Glucose-6-phosphate dehydrogenase; MDH, Malate dehydrogenase.
Values represented are percent changes (decrease/increase) from normal values.

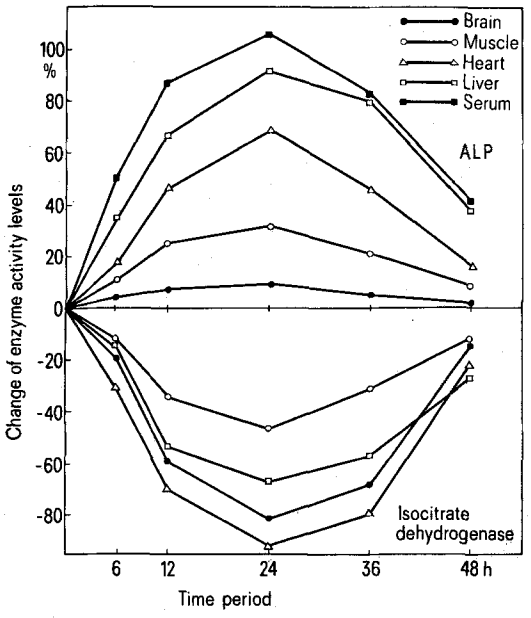


Fig. 2. ALP, Alkaline phosphatase.

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