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EFFECTS OF STARVATION ON TISSUE RESPIRATION OF SOME THERMO-CONFORMERS

THERE is a good correlation between mitochondrial content and oxygen uptake of tissues excised from different organs[1]. At structural level, starvation has been shown to cause swelling, rounding and loss of certain parts of the mitochondria in fishes and rats[2]. Decreasing trends in the oxygen uptake of different tissues excised from the fasting rats have been demonstrated as function of starvation stress[3]. Studies on the oxygen consumption of thermo-conformers as function of starvation have so far been made only at the organismic level[4-6]. This note reports on the changes in the tissue respiration levels of some important organs of the starving fish *Ophiocephalus striatus* and frog *Rana hexadactyla.*

Individuals of *O. striatus* (about 4 g) and *R. hexadactyla* (about 14 g) were fed in the laboratory for a few days and subsequently starved (at 23° ± 1° C). From the stock, one starving fish was killed every alternate day; liver and muscle were excised from it and immediately transferred into cold physiological saline (0·9% NaCl). Almost every day a frog was pithed and its brain, liver and leg muscle tissues were removed and transferred into frog's ringer[7]. Oxygen uptake of the tissues was measured following the standard manometric procedure described by Umbreit *et al.*[8].

Liver of the fish consumed 404 µl/g/h on the zero day of starvation (Fig. 1); its oxygen uptake decreased to 270 and 190 µl/g/h on the 3rd and 10th day of starvation, respectively. Decrease in the oxygen consumption of liver was remarkably more during the initial period than during the subsequent period of starvation. Muscle too exhibited a similar trend in its oxygen uptake; its oxygen consumption was 45 and 15 µl/g/h on the zero day and the 36th day of starvation.

Oxygen uptake of brain of a well-fed frog was 401 µl/g/h (Fig. 1); it gradually decreased to 350 µl/g/h for that of the frog starved for 40 days and then, remarkably to 213 µl/g/h for that of the frog starved for 60 days. Oxygen consumption of liver of the frog decreased rapidly during the first 4 days of starvation (from 301 to 185 µl/g/h); subsequently, it gradually decreased to 95 and 70 µl/g/h for that of the frogs starved for 40 and 60 days, respectively. Thigh muscle of the frog displayed more or less similar decreases in its oxygen consumption it was 211 and 47 µl/g/h for that of the frogs starved for zero and 60 days.

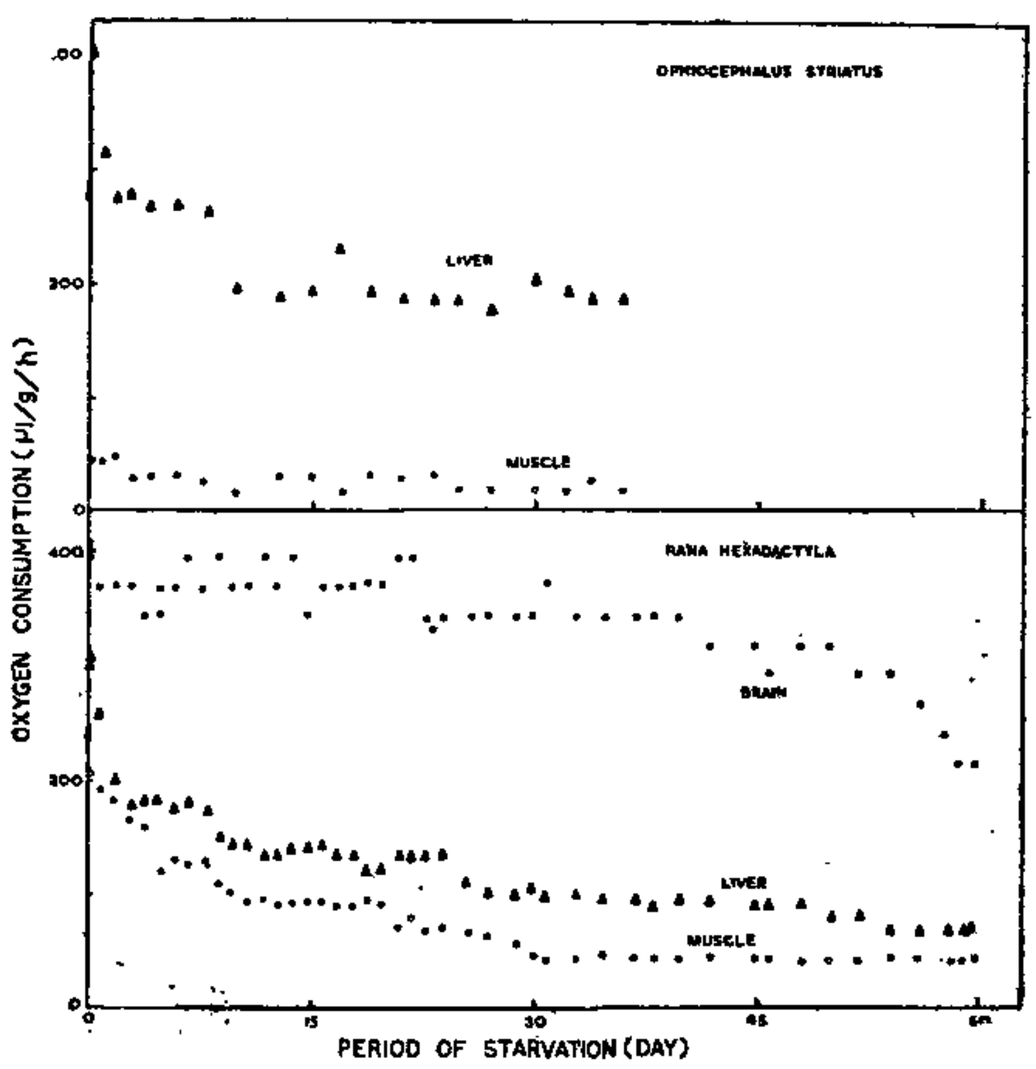

FIG. 1. Oxygen consumption of brain, liver and muscle of the fish *Ophiocephalus striatus* above and the frog *Rana hexadactyla* (below) as function of period of starvation.

In both the species, liver and muscle displayed a rapid decrease in the oxygen consumption during the initial period of starvation; this was followed by a gradual decrease during the subsequent days of starvation. Oxygen uptake of liver of well-fed fish and frog was more than 300 µl/g/h, while that of muscle of the frog and fish was 211 and 45 µl/g/h, respectively; the oxygen uptake of the muscles are relatively low, as a considerable part of energy requirements of muscle is met by anaerobic decomposition of glucose[9]. Decreasing trends of the oxygen uptake of these 2 reserve organs (liver and muscle) resemble those obtained for the starving lung fish[4] and the frog[6]. Smith[4] found that rate of oxygen consumption of the straving lung fish decreased logarithmically with starvation upto 300 days. Hill[6] observed that the starving frog reduced its oxygen uptake to 60% of the initial level within a week and after this initial rapid reduction, it did not appreciably decrease its

oxygen consumption. It is evident from the present studies that the oxygen consumption of the starving frog's brain is maintained at about 90% and 85% of the initial level until the 20th and the 40th day of starvation, respectively and subsequently, rapidly decreased to about 55% of its initial level on the 60th day of starvation.

Reduction in the oxygen uptake of tissues of starving animals is brought about through the decrease in mitochondrial content, and the consequent inhibition of oxidation owing to the deficiency of one or more enzymes in the Kreb cycle. This reduction is set in different organs after different periods of starvation stress. For instance, inhibition of oxidation occurs in the liver of the starving frog (before the 15th day of starvation) earlier than that of brain (between the 40th and the 60th day of starvation). Pandian and Ramachandra Rao[10], who have investigated the effects of extracts of brain of well-fed or starved frog on the tissue respiration, have shown that the extract of brain of the 50-day starved frog depressed the oxygen uptake of tissues (liver and brain) excised from the well-fed frog, while that of the well-fed frog enhanced it in these tissues of the 50-day starved frog.

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NOTE ON A CASE OF DEATH DUE TO JELLY FISH STING IN GULF OF MANNAR

THE danger of jelly fish stings has been reported by Phisalix (1922), Pawlowsky (1927), Henderson (1945), Halstead (1957, 1959) and Barnes (1963). The venomous nature of the jelly fishes like *Chiropsalmus* sp. (sea-wasp), *Cyanea* sp. (sea-blubber), *Dactylometra* sp. (sea-nettle), and the siphonophores like *Physalia* sp. (Portuguese man-o-war) has been described by Light (1914), McNeil and Pope (1943), Pope (1953), Chu and Cutress (1954), Southcott (1959) and Halstead (1965, 1969).

Apparently death due to jelly fish sting has not been reported so far from India. On 8-7-1971, one fisherman from Keelakarai (Gulf of Mannar) was found missing during the operation of a shore seine in *Appa thievu*, an island seven miles off Keelakarai. When his body was recovered from the sea next day, there were blisters and inflammatory rashes on face, neck, right side of the chest and stomach. Some of the blisters had burst open exposing the wounds. These evidences seem to indicate death due the sting of jelly fishes like *Chiropsalmus* sp., which is known to occur in Gulf of Mannar and is known in Tamil as *Naalu moolai chori* (*Naalu* = four, *moolai* = corner, *chori* = jelly fish). Its sting is known to cause similar symptoms as above (Halstead, 1965).

Such a conclusion is also borne out by an earlier instance. In April 1971 a fisherman of the same village was also stung on the abdomen and waist. He could not be saved even though he was removed to a boat in an unconscious state immediately after the sting. He died before reaching the shore. It is also reported that the tentacles removed from his body, falling accidentally on others, caused severe pain and inflammatory rashes lasting three days. There appear to have been three deaths during this year due to the sting of the jelly fish in Keelakarai.

According to Halstead (1959) the symptoms of jelly fish sting are shooting pain, reddening of the skin followed by severe inflammatory rashes, blistering, swelling and minute skin haemorrhages. In severe cases in addition to shock there may be muscular cramps, abdominal rigidity, vomiting, sensation of constriction of throat, respiratory difficulties and convulsion resulting in death. Death may take place within 30 seconds to 3 hours, but the usual time is less than 15 minutes (Halstead, 1969) due to allergic shock and respiratory failure.