

EFFECTS OF TEMPERATURE ON BLOOD SUGAR LEVELS IN THE SKATE, Raja erinacea*

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As part of a general investigation into the endocrine control of carbohydrate metabolism in elasmobranchs, skates (Raja erinacea) were placed in a water bath containing aerated sea water at varying temperatures and their blood sugar levels determined by the glucose oxidase method. Four animals which were gradually raised from 13.5°C to 25.0°C over a four hour period showed an average rise in mg% glucose of 12.9%/°C and a total mean rise of 39.4 mg% (149.1% rise). Another group of three animals raised from 12°C to 21°C for three additional hours showed a plateau effect in sugar values with a mean rise of 14.6mg% and a change of 66.8%. When both of the above groups were returned to base temperatures (12.0-13.5°C) in running sea water, the first group showed a drop of only 22.8% in twenty-four hours from their highest glucose levels while the second group returned to approximately their original levels. An average rise in mg% glucose of 67.5% was recorded for three animals which received heat shock treatment in which they were placed directly from 15.0°C conditioning temperature into a bath at 25°C for one hour. Although all animals showed partial recovery of original glucose levels after return to their base temperature, all died within twelve hours.

Cold shock was induced by placing two animals from 13°C into 3°C sea water. They showed a mean rise of 23.5% in mg% glucose in one hour. When water temperatures were brought slowly to 19.8°C a rise of 77.0% in blood sugar was obtained; a value which showed reasonable correspondence to the 66.8% rise recorded for animals whose glucose levels plateaued at 21.0°C. When water temperatures were lowered gradually from 12.0°C to 5.0°C over three hours, sugar values from four animals showed considerable divergence. Two animals with the lowest initial glucose levels of 25.4 and 29.8 mg% showed a rise in mg% of 46.2%. The other skates with higher original values of 81.9 and 45.1 mg% glucose showed a drop in mg% of 36.7 and 26.1% respectively. The rate of spiracle contraction, which was taken as a rough index of respiratory activity, varied directly with temperature. In control studies no differences in spiracle rate were found in skates from running or artificially aerated sea water at the same temperature.

The results of these temperature studies are of particular interest, as previous investigations have shown that stress factors such as handling, anesthesia, and withdrawal of blood samples have no effect on blood sugar levels. Animals treated with nor-epi-nephrine and epinephrine show pigment concentrations and a rise in blood glucose. As animals in which glucose values rose following temperature changes also presented a bleached appearance it is probable that catecholamines were the effective gluconeogenic factors. The fall in blood sugar after raised temperatures and in animals with high original values is probably due to the release of diabetogenic principles which in the skate have their maximum effect when glucose levels are high.

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